# U.S. Air Force

## Environmental Impact Analysis Process

# Special Environmental Assessment

*For*

# Operation Desert Storm Support Operations



*At*

# Westover AFB Massachusetts





May 1991

**Air Force**
**Environmental Planning Division**
**(HQ USAF/CEVP)**

Room 5B269
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Washington, DC 20330-1260

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OFFICE OF THE ASSISTANT SECRETARY

APR 26 1991

TO: INTERESTED AND AFFECTED PARTIES

Attached is a copy of a Special Environmental Assessment for Operation Desert Storm Support Operations at Westover Air Force Base, Massachusetts. This Special Environmental Assessment was prepared at the request of the President's Council on Environmental Quality.

This copy of the Special Environmental Assessment is being forwarded to you because of your previous interest in the 1987 Environmental Impact Statement for the beddown of the C-5 Aircraft at Westover AFB.

We appreciate your interest in this matter. Comments regarding this document should be forwarded by June 3, 1991 to:

Mr. Robert C. Martin, Jr.
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GARY D. VEST
Deputy Assistant Secretary of the Air Force
(Environment, Safety and Occupational Health)

1 Atch
Special Environmental Assessment

## Table of Contents

## List of Figures



## List of Tables

## Acronyms and Abbreviations

AFB ..... Air Force Base
AFRES ..... Air Force Reserve
AGL ..... above ground level
AICUZ ..... Air Installation Compatible Use Zone
ANG ..... Air National Guard
BAI ..... backup aircraft inventory
BASEOPS ..... Computer program used to input aircraft operations data for noise modeling
CEQ ..... Council on Environmental Quality
CERL ..... (U.S. Army Corps of Engineers) Construction Engineering Research Laboratory
CFR ..... Code of Federal Regulations
CHABA ..... Committee on Hearing and Bioacoustics
Db ..... decibel
DNL ..... day-night average noise level
EA ..... environmental assessment
EIS ..... Environmental Impact Statement
FONSI ..... finding of no significant impact
FY ..... Fiscal Year
IFR ..... instrument flight rules
MAC ..... Military Airlift Command
mi ..... mile
MSL ..... Mean Sea Level
NEPA ..... National Environmental Policy Act of 1969
NOISEMAP ... Computer program used to model aircraft noise around installations
PAA ..... primary assigned aircraft
SEL ..... sound exposure level (dB)

# SECTION 1 PURPOSE OF AND NEED FOR ACTION

Airlift is playing a crucial role in transporting troops and material involved in Operation DESERT STORM from the gulf region in Southwest Asia back to the United States. The continued use of Westover AFB for C-5 transport is essential to accomplish the return of this material critical to military readiness.

## 1.1 PURPOSE OF AND NEED FOR ANALYSIS

Under the National Environmental Policy Act (NEPA) of 1969, and the Council on Environmental Quality (CEQ) *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act* (40 CFR 1500-1508), Federal Agencies are required to take into consideration the environmental consequences of proposed actions in the decision making process.

The Department of Defense (DoD), however, has been reacting to a dynamic situation in the Middle East requiring quick action. DoD, with the concurrence of CEQ, has characterized any activities conducted, or caused to be conducted, as a result of DESERT STORM and DESERT SHIELD as emergencies. In emergencies, CEQ Regulation 40 CFR 1506.11 allows Federal Agencies to take actions having significant environmental impact without complying with all of the requirements of the regulations, including the requirement to prepare an environmental impact statement. In such cases, the Regulations state that the agency or agencies taking the action should consult with CEQ about alternative arrangements for actions necessary to control the immediate impacts of the emergency.

The Air Force has consulted with the Council on Environmental Quality, and on March 19, 1991, CEQ requested an environmental assessment (EA) of the on-going DESERT STORM operations at Westover AFB, Massachusetts be prepared as an alternative arrangement (see Appendix A). CEQ directed the Air Force to:

- Prepare a special environmental assessment documenting the environmental impacts of operations which exceed the nature and number of flights preceding DESERT SHIELD.

- Analyze noise impacts, reasonable alternative landing sites on the East Coast, reasonable alternatives to current flight patterns, including reduction of nighttime departures, and other mitigation possibilities.
- Provide the assessment to the CEQ, the Environmental Protection Agency (EPA), the Massachusetts Executive Office of Environmental Affairs, and interested and affected parties.
- Provide a thirty-day period for public comment on the special environmental assessment.
- Respond to all substantive comments received and provide copies of all comments and responses regarding the special environmental assessment to CEQ and EPA.

CEQ has indicated that one of the primary purposes of this analysis "is to inform the public about the environmental impacts of [the] actions" and provide the public an "opportunity to participate in [the] analysis."

## 1.2 BACKGROUND

On August 2, 1990 the Republic of Iraq invaded Kuwait. On that day, President Bush declared "...the policies and actions of the Government of Iraq constitute an unusual and extraordinary threat to the national security and foreign policy of the United States..." One week later the President further outlined to Congress that United States armed forces would deploy to the gulf region.

This deployment was followed, after several attempts to resolve the situation peacefully, by combat operations that began on January 16, 1991. Kuwait was liberated approximately six weeks after hostilities commenced.

The timely return of troops and material is critical to military readiness. As the forces currently deployed have other, world-wide contingency missions, the crisis situation will continue until U.S. troops and material have completed their mission in the gulf region and are returned to their home stations in the United States.

As long as these forces are deployed in the gulf area and therefore not fully available for those other world-wide missions, the capability of the United States to deter and, if necessary, respond to other threats to the national security is lessened. Accordingly, from a national security and military operational perspective, the emergency represented by Operations DESERT SHIELD and DESERT STORM will not be fully over until the deployed forces and material become available for other missions. The redeployment of forces from the gulf region as rapidly as the evolving situation and available transportation assets will allow is necessary to assure combat readiness and availability for

other military missions. Failure to remove forces in a timely manner could jeopardize international diplomatic commitments made to Arabian Peninsula allies.

Although Kuwait has been liberated and Iraq has accepted United Nations' terms for ending the hostilities, U.S. forces remain in the region. Unexpected contingencies may arise in the gulf region that require involvement, deployment or redeployment of US troops and material. An example of this is the recent airlift of food and other humanitarian relief material to the Kurdish refugees in northern Iraq.

Notwithstanding the continuation of these activities, there is strong sentiment for an immediate and rapid return among both the troops deployed and their families in the United States. President Bush has indicated that the national goal is to return the troops by July 4, 1991.

In addition, the C-5 Wing at Westover AFB has been advised that it is scheduled to demobilize on July 15, 1991. Operations at the base would be expected to return to those described in the 1987 Environmental Impact Statement (EIS) and the 1990 Air Installation Compatible Use Zone (AICUZ) Study.

## 1.3 AIRLIFT OPERATIONAL SUPPORT

Airlift is the only means by which to accomplish a quick return of troops and material critical to military readiness. Airlift may also be the only means to respond to any evolving situation in the gulf, such as the Kurdish relief operation. Additionally, airlift is the principle means of supplying U.S. forces continuing activities in the gulf with critical spare parts and other material.

Airlift of critical items such as communications equipment and high technology weaponry is necessary to give airborne and other deployable U.S. forces an advantage over larger opposing forces. These U.S. forces also require special tools, diagnostic equipment, and basing facilities such as personnel and maintenance shelters. Other equipment needed to sustain operations includes material handling equipment to unload aircraft and construction equipment for earthwork. This package of weapons, equipment, and facilities is needed to conduct operations in any location world-wide and can be required to deploy within 24 hours of alert. The result is that this important material cannot be transported by ship. Putting it to sea, coupled with the time necessary to on-load and off-load the cargo, would cause a delay of 45 to 60 days which is unacceptable for this material.

### 1.3.1 C-5 Galaxy

U.S. military airlift resources are being used to accomplish the return of the troops and their material. To meet the need, the Air Force is using virtually all of its strategic transport assets around the clock. C-141 Starlifter and C-5 Galaxy aircraft are providing airlift on the long transcontinental flights to and from the gulf region. These aircraft are being supplemented by civilian contract flights to assist with troop airlift.

The C-5 is extremely important to the repositioning effort. It is the largest air cargo mover and is the only aircraft in the US inventory that can handle the many oversize loads of cargo returning from the gulf. Although the C-5 can transport up to 73 passengers in its normal configuration, it predominately carries cargo, including such oversize cargo as helicopters, M-1 tanks, generators, mobile assault bridges, mine clearing equipment, and construction equipment.

### 1.3.2 United States Transportation Command

The United States Transportation Command (USTRANSCOM) controls the airlift resources supporting US forces in the gulf region. The C-5 operations conducted at Westover AFB are in direct support of the operational requirements for the transportation of troops and material to and from the gulf region.

### 1.3.3 The "Pipeline"

To best make use of the C-5 airlift resources, a "pipeline" flow of aircraft is being used. This "pipeline" operation is used to keep the aircraft in constant motion, continually moving troops and material to and from the gulf. To maximize the efficiency of the operation, specific routes have been established for airlift operations.

For the C-5's, the pipeline "flows" from the U.S. to the gulf and back. The operations generally follow a specific route, moving east from Dover AFB, Delaware to Rhein Main AB or Ramstein AB, Germany to the gulf region and west from the gulf to Torrejon AB, Spain to Westover AFB (See Figure 1.1). C-5's can enter and exit this constantly "flowing" pipeline at any point along the route as planes conduct other missions supporting US forces elsewhere in the world.

To illustrate this pipeline route, a C-5 would fly to any location in the U.S (for example, Tinker AFB, Oklahoma) to load cargo going to the gulf. The plane would then fly to Dover AFB, Delaware

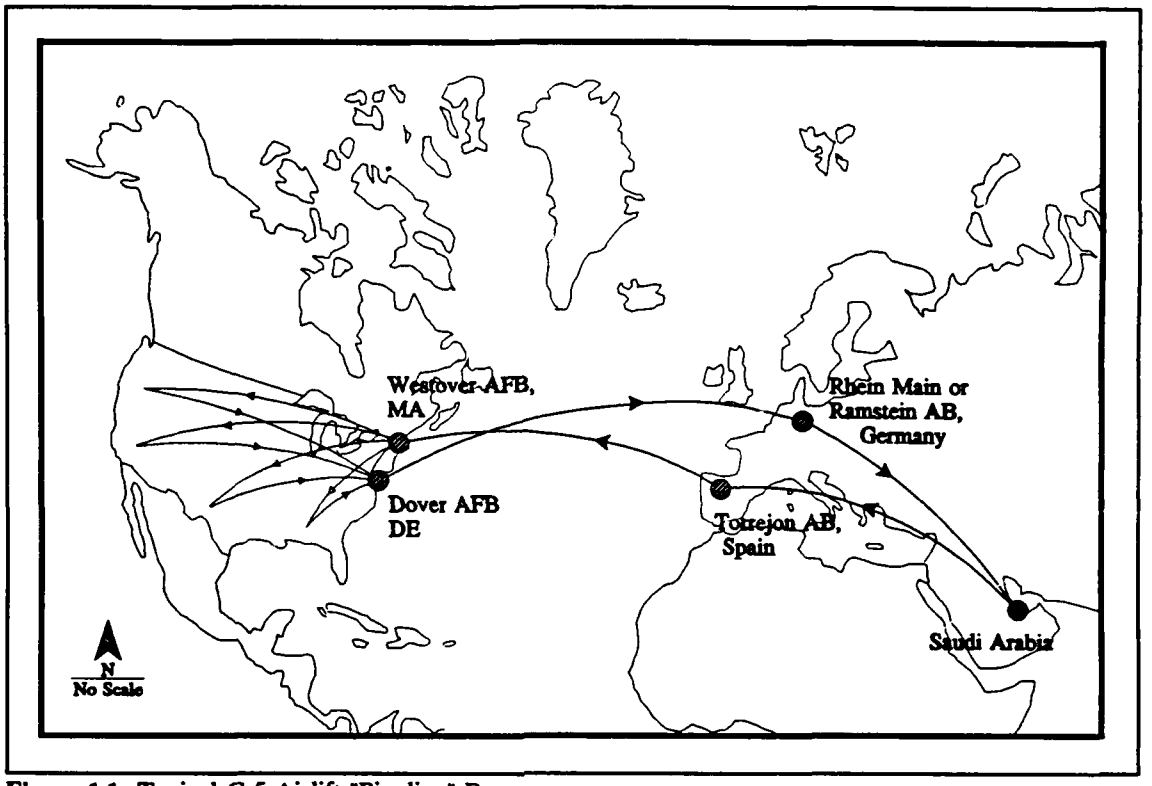


**Figure 1.1** Typical C-5 Airlift "Pipeline" Routes

to refuel and change crews. From Dover AFB, the plane would fly to Rhein Main AB or Ramstein AB in Germany for refueling and another crew change prior to the final leg to the gulf region. In the gulf region the inbound cargo is unloaded and material returning to the U.S. is loaded. Up to 73 passengers may also be transported back to the U.S. On the return leg, the C-5 flies from the gulf region to Torrejon Air Base, Spain prior to the return flight across the Atlantic to Westover AFB, Massachusetts. From Westover AFB, the C-5 would fly to any point of debarkation (for example, Pope AFB, North Carolina) to deliver troops and material. After delivering the returning troops and cargo, the C-5 would fly to a U.S. C-5 base to exchange crews and begin another mission.

### 1.3.4 Stage Bases

The C-5 stage bases at Dover, Delaware, Rhein Main or Ramstein AB, Germany, Torrejon, Spain, and Westover, Massachusetts, are pivotal points in the pipeline working to refuel, service, maintain and repair the C-5 aircraft to keep the pipeline operating. These stage bases are located at strategic points along the route to the Middle East and serve as exchange points for aircraft crews.

### 1.3.4.1 C-5 Base

Westover has been operating as a C-5 base since 1987 and has the unique expertise and infrastructure needed to support C-5 stage base operations. Westover AFB is capable of simultaneously fueling and servicing three aircraft within 3 1/4 hours, a critical time limit required to sustain pipeline operations.

If an arriving C-5 requires more than just routine fuel and service, diagnostic computers, test equipment, tools and spare parts are available to get the plane back into the pipeline. Westover AFB has hangar facilities large enough to enclose the C-5 to allow repairs to continue through all hours of the day or night regardless of the weather.

When several aircraft arrive over a short interval, the base has adequate ramp space to temporarily park arriving planes until fuel, service (and repair operations) can catch up.

Other equipment essential for successful C-5 stage operations include special de-icing trucks to reach the six story height of the stabilizer tail and forklifts, K-loaders, scales, aircraft tow bars and tugs for aircraft and cargo handling.

Making all this work are the dedicated and professional reservists called to active duty to support DESERT SHIELD and DESERT STORM operations during the emergency. From the specially trained maintenance and service crews to the airman driving the crew bus, Westover AFB is making their C-5 support training and the experience gained since DESERT SHIELD started in August 1991 work to accomplish the mission.

More than 1500 Westover AFB reservists were called to active duty between August 1990 and March 1991. Only about 140 reservists actually deployed from the base. The remaining personnel have been supporting operations right at Westover.

Other necessary services in place at Westover include daily contract air freight service delivering out of stock spare parts and local hotels and restaurants serving the aircraft crews and passengers.

It should also be noted that the off base community has established itself as a significant factor in the stage base operation at Westover AFB. To show their appreciation to the troops for the sacrifices made and a job well done, the community has rallied local support and has set up a welcoming center. Hundreds of members of the community turn out daily to roll out a red carpet and give the returning troops a standing ovation. The center has been decorated by well-wishers and local businesses have donated meals, beverages, toiletries, sports equipment and other items to create a sensational impact

for the returning troops. As of March 1991, over $50,000 has been donated by the local community to support the operation.

#### 1.3.4.2 Location

Stage bases are located at strategic points in the pipeline. Westover is the first C-5 base in the United States on the Great Circle Route[1] from Torrejon AB, Spain. From Torrejon, Spain, Westover AFB is closer in flying time than Dover AFB. The advantage of landing at Westover rather than at a base further away is that not as much fuel is required for the trip. The reduction in the weight of the required fuel allows more cargo to be transported.

#### 1.3.4.3 Crew Rest

For safety reasons, the Air Force has limited the crew duty day to 20 hours. The Torrejon to Westover leg of the pipeline allows crews to cover a long distance, perform necessary preflight activities and leave enough time for any contingencies such as a preflight aircraft malfunction or stiffer than normal headwinds over the North Atlantic without exceeding this 20 hour limit. After arrival at Westover AFB, crews are taken to their hotel to begin crew rest while the aircraft is fueled and serviced and a relief crew prepares to continue the journey to the next U.S. destination.

## 1.4 ORGANIZATION OF THIS ENVIRONMENTAL ASSESSMENT

This special environmental assessment follows the following format:

1. Purpose Of and Need for Action
2. Alternatives Including the Proposed Action
3. Affected Environment
4. Environmental Consequences
5. List of Preparers
6. References

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[1]The Great Circle Route is the shortest air route between any two points on the globe.

# SECTION 2 ALTERNATIVES INCLUDING THE PROPOSED ACTION

This Section begins with a description of the current and projected operations and describes alternatives considered: (1) Discontinue C-5 airlift operations; (2) Move C-5 stage operations to another base; (3) Split stage operations between Westover AFB and Stewart ANGB; and (4) Modify C-5 operations at Westover AFB. Modification of operations at Westover was determined to be the only reasonable alternative and is the only alternative addressed in detail in this analysis.

Reduction or discontinuation of night operations at Westover AFB was evaluated and determined not to be feasible due to scheduling impacts throughout the pipeline. Six other alternatives for modification of operations at Westover were determined to be feasible and were identified for detailed analysis: (1) Continue use of the current night runway use procedures as the only mitigation measure; (2) Discontinue the current night runway use procedures; (3) Utilize alternate departure flight tracks for operations on Runway 23 only with no runway use control; (4) Use alternate departure flight tracks on both Runway 05 and 23 without runway use control; (5) Use alternate departure flight tracks for operations on Runway 23 only in combination with night runway use control; and (6) Use alternate departure flight tracks for operations on both Runway 05 and 23 in combination with night runway use control. This section concludes with a comparison of the predicted impacts of these operational modification alternatives and recommends implementation of the use of alternate departure flight tracks in combination with the current night runway use controls to further reduce the number of people impacted by aircraft noise.

## 2.1 PROJECTED OPERATIONS

### 2.1.1 Background

Westover's involvement started shortly after the Iraqi invasion of Kuwait. Beginning August 7, 1990 C-5 missions were manned by volunteer crews from the base. Base support functions operated with the help of other volunteer reservists. On August 8, 1990 the control tower and base operations went into 24-hour operation. On August 24, 1990 the first reserve members were called to active duty

in support of Operation DESERT SHIELD. This call-up was followed by other call-ups as Westover organized to provide stage base and flying support.

Support of Operations DESERT SHIELD and DESERT STORM has reduced the number of C-5 aircraft operations[2] at Westover AFB from approximately 220 per week prior to August 1990 to approximately 150 per week during the period from January through March 1991. Following the initiation of Operation DESERT SHIELD, MAC suspended all pilot currency training requirements, resulting in the virtual elimination of local training sorties and associated closed pattern operations at Westover AFB. Aircraft supporting operations in the gulf use instrument approaches and maintain runway heading on departure until approximately 5 miles from the base.

Prior to Operation DESERT SHIELD, operations at Westover AFB were normally completed prior to 10 p.m. and there were essentially no operations between 10 p.m. and 7 a.m. With the initiation of Operation DESERT SHIELD, tower operations were extended to 24-hours per day and aircraft arrive and depart throughout the entire 24-hour day. An analysis of the operations between January and March of 1991 indicated that approximately 35 percent of the operations occurred between 10 p.m. and 7 a.m. (if distribution of operations had been perfectly uniform, nine twenty-fourths or 37.5 percent of the operations would have occurred during these hours.)

In an effort to minimize the number of persons disturbed by night operations, Westover AFB has initiated a program in which pilots are requested to use Runway 23[3] for arrival and runway 05 for departure between 11 p.m. and 7 a.m. whenever the wind conditions permit[4]. Air traffic control personnel at Westover estimate that the preferred runways are used for more than 90 percent of the operations between 11 p.m. and 7 a.m.

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[2]An operation is defined as either an arrival or a departure; touch-and-go operations conducted during training flights count as two operations.

[3]Runways are identified by the first two digits of the compass heading (rounded to the nearest ten degrees) of an aircraft operating on the runway. In the case of Runway 23, the actual heading of 228° is rounded to 230° and identified by the first two digits.

[4]Military Airlift Command (MAC) Regulation 55-2, *C-5 Airlift Operations*, requires a change in runway whenever the tailwind (i.e., the component of the wind speed parallel to the runway in the direction of aircraft movement) exceeds 10 knots. An analysis of wind speeds and directions conducted during preparation of the 1987 EIS indicated that the preferred runways could be used more than 90 percent of the time.

### 2.1.2 Projected Operations

USTRANSCOM projects that the level of operations may increase for periods of time to approximately 40 per day (20 arrivals and 20 departures). This compares to average levels during Operation DESERT STORM of about 22 operations per day. For purposes of this analysis, it was assumed that approximately 35 percent of the total operations would continue to occur between the hours of 10 p.m. and 7 a.m.

## 2.2 ALTERNATIVES TO THE PROJECTED OPERATIONS

### 2.2.1 Discontinue C-5 Airlift Operations

Ceasing C-5 operations would severely impact the ability to reconstitute the armed forces to deter and if necessary to respond to other threats to national security. While all of the troops and some of the equipment could be depositioned by other aircraft, only the C-5 can airlift the outsized equipment and other material needed by US forces. Ceasing C-5 operations would force this outsized equipment to be returned by sealift. This in turn would make it unavailable for the approximately 45-60 days it is in transit. Ceasing C-5 operations would also shift most of the airlift burden to C-141 aircraft (which operate in another pipeline from other stage bases). The elimination of C-5's with its relatively large cargo capacity (roughly three C-141's are required per C-5) would significantly stretch out the repositioning effort.

Additionally, international diplomatic commitments to American allies and coalition partners require the withdrawal of U.S. forces from the gulf region as soon as the situation allows.

For these reasons, the Discontinue C-5 Airlift Operations alternative is considered unreasonable.

### 2.2.2 Move C-5 Stage Operations to Another Base

Only C-5 bases have the expertise and infrastructure necessary to support C-5 stage base operations. While some unique support equipment such as loaders and service equipment is mobile and can be moved to any airbase to support C-5 operations, certain components such as tools and spare parts inventory would be difficult to move and other components such as C-5 hangers, ramp space, test equipment and diagnostic computers could not be moved. Additionally, only bases in the Northeast are close enough to Torrejon AB to maximize cargo loads and meet crew rest requirements.

Besides Westover AFB, only Dover AFB, Delaware and Stewart Air National Guard Base, New York fit these criteria as a C-5 stage base. The transfer of stage base operations from Westover would end the need for off base hotel and restaurant services in the Westover area and would end welcoming center activities.

#### 2.2.2.1 Dover AFB

Dover AFB is the stage base supporting outbound C-5 operations to Germany. It also supports some inbound C-5 traffic which has been diverted from the pipeline route due to operational or weather factors and some commercial wide body jets contracted to support US forces. With these operations, Dover AFB is operating at capacity and could not accept the increase associated with both in bound and out bound operations.

#### 2.2.2.2 Stewart Air National Guard Base

Stewart Air National Guard Base (ANGB), located near Newburgh, NY, is capable of supporting C-5 stage base operations. Although some equipment such as forklifts, loaders, refueling vehicles, etc. would need to be provided, Stewart ANGB can simultaneously fuel and service three aircraft within the 3 1/4 hour time limit needed to sustain C-5 pipeline operations. It also has the facilities, diagnostic computers, test equipment, tools and spare parts to repair C-5 aircraft and the ramp space to temporarily park an influx of arriving planes.

Like Westover AFB, Stewart is not an active duty airbase. It is operated by the New York Air National Guard. However, unlike Westover AFB, Stewart ANGB has not been activated during this emergency. To be able to support C-5 stage base operations, Stewart ANGB would need to be activated and its guardsmen called to active duty. Over 1200 guardsmen would need to be called to active duty to support stage base operations. The call up of guardsmen would be contrary to the current trend of reserve forces being released from duty as US troops and material return from the gulf.

The depositioning of the troops and material is expected to be completed as rapidly as the situation in the gulf and available transportation assets will allow. Westover AFB is expected to demobilize on July 15, 1991.

Westover AFB has been operating as an active duty base since August 1990 and is experienced with C-5 stage base support operations. Although Stewart ANGB could begin servicing aircraft within

48 hours, there would be an unavoidable loss of efficiency while support operation responsibilities are transferred to Stewart ANGB. It took Westover AFB months to gain the experience necessary to create a stage to operate as effectively as the established and experienced active duty stage bases at Dover, Torrejon, Rhein Main, and Ramstein. It could also take months for Stewart ANGB to reach this level of proficiency. Moving stage base operations would mean deactivating Westover AFB and releasing reservists from active duty.

For these reasons, the Move C-5 Stage Operations to Another Base alternative is considered unreasonable and has been eliminated from further consideration.

### 2.2.3 Split C-5 Stage Operations Between Westover AFB and Stewart ANGB

Splitting Westover AFB stage operations would essentially require the same numbers of Stewart guardsmen to be activated as would the previous alternative. Aircraft maintenance and other support tasks require 24-hour/7-day work shifts. These guardsmen would also need to gain the experience necessary to create a stage and operate effectively.

Additionally, if the operation were to be split at all, to do it would be extremely difficult. Support equipment such as tow bars, loaders, refueling vehicles, etc. would need to be provided for operations at Stewart ANGB. Some of this equipment is not available in the United States, or is in extremely short supply. Transferring equipment from one base to another would seriously impact operations at the donor base. Increased levels of spare parts and war reserve augmentation kits would be needed to service pipeline aircraft.

Splitting the operations would also split the number of aircrews available to keep the pipeline moving. For example, if operations were evenly split, the crews available at one base would be halved. This would reduce the flexibility of assigning crews with the needed crew rest to aircraft fueled, serviced and ready to proceed to the next destination. This slowdown would ripple through the pipeline.

If all factors were not overcome, this situation could stall the C-5 operation. For these reasons, the Split Stage Operations Between Westover AFB and Stewart ANGB alternative is considered unreasonable and has been eliminated from further consideration.

### 2.2.4 Modify C-5 Operations at Westover AFB

#### 2.2.4.1 Reduce or Discontinue Night Operations

Airlift in support of DESERT SHIELD, DESERT STORM, and the Kurdish relief effort is a massive undertaking. In order to fly the thousands of missions required, an around-the-clock operation is needed. Aircraft are flown non-stop. They are only on the ground to load and unload cargo, refuel and perform maintenance.

Scheduling missions to arrive or depart at certain locations at specific times would severely limit pipeline operations. There are already a large number of constraints that currently impact scheduling. These include:

- Daylight operating constraints at several gulf region airfields due to physical limitations, such as a lack of adequate lighting and navigation aids preventing night operation
- Fuel and service limitations restricting the number of aircraft operating through the airfield during a given amount of time. This number is limited in some cases by the amount of fuel available, the personnel available to load and unload the aircraft, and other factors. The Air Force is operating from some gulf region airfields where only one C-5 can be fueled and serviced at one time. This forces 24-hour operations in order to get the required number of daily missions through the base.
- Restrictions limiting operating hours at other bases. Although the European allies have waived operating restrictions such as "quiet hours," there are still many constraints in place. Most are because there are no workers at the airport.

Every constraint complicates the airlift scheduling problem and, in some cases, makes it impossible to fly a mission without decreasing efficiency. Diversions or delays to avoid restrictions extend delivery times and tie up valuable assets.

Every new restriction adds limitations an compounds existing problems. When missions are scheduled around restrictions, they are at further risk from the inefficiencies built into the schedule. For example, if aircraft are delayed at Torrejon AB to arrive at Westover between 7 a.m. and 10 p.m., the mission may have to be further delayed by weather when the departure window arrives.

An additional complicating factor is that military bases in Europe also have quiet hour restrictions similar to those normally in place at Westover AFB. These quiet hours have not been enforced during DESERT SHIELD and DESERT STORM operations. However, if quiet hours were to be scheduled at Westover, it would be very difficult to resist them in Europe. The enforcement of quiet hours at European locations, coupled with quiet hours at Westover, would geometrically increase the scheduling problems since U.S. and European bases are about 10 hours apart.

In summary, the scope of airlift operations necessitates around-the-clock operations. The flow could not be concentrated into a limited time period without exceeding fuel and service limitations and creating unmanageable surges in a wide range of operations.

For these reasons, the Reduce or Discontinue Night Operations alternative is considered unreasonable and has been eliminated from further consideration.

#### 2.2.4.2 Continue Current Night Runway Use Control

Currently, Westover AFB recommends use of Runway 23 for landing (to the south) and Runway 05 for takeoffs (to the north) to pilots between 11:00 pm and 7:00 am to minimize the number of area residents affected by noise from night operations. Although it is up to the pilot's discretion on which runway to use (ie wind direction and speed may influence the runway choice), about 90% of the time, pilots use the recommended runways for nighttime operations. Westover AFB does not recommend specific runway use to mitigate noise impacts during other hours.

#### 2.2.4.3 Discontinue Night Runway Use Control

As previously noted, Westover has instituted procedures which call for the maximum possible use of Runway 05 for departures and Runway 23 for arrivals between the hours of 11 p.m. and 7 a.m. in an effort to minimize the number of people affected by night operations. This measure increases the noise levels in the area to the northeast of the base. Discontinuation of this runway use alternative would reduce the impacts to persons living in this area. If night runway use procedures were discontinued, Runway 23 would be used for about 80 percent of all operations with landings from the northeast over Granby and departures to the south over Chicopee and Springfield.

#### 2.2.4.4 Use Alternate Flight Tracks

Aircraft operating at Westover currently normally make a straight in approach and maintain the runway heading on departure until they are approximately 5 miles from the base. Utilization of alternate approach flight tracks for either runway was not considered operationally feasible in the vicinity of the base; however, use of alternate flight tracks for departure appears to be feasible and was investigated. Initiating turns closer to the runway would disperse the operations in the vicinity of the installation and decrease noise levels in the areas near the extended runway centerline. Use of alternate

flight tracks would increase the noise levels in areas near the new flight tracks. To provide an indication of the effectiveness of using alternative flight tracks, 80 percent of the aircraft departing Westover were assumed to initiate a turn of approximately 40 degrees (equally distributed between left and right turns) as soon as they reach an altitude of 600 feet.

2.2.4.5 Summary of Operational Modification Alternatives Selected for Analysis

A discussed above, a total of six alternatives for conduct of projected C-5 stage operations were identified for detailed analysis of noise impacts:

- #1 — Continue the current night runway use controls
- #2 — Discontinue night runway use control
- #3 — Alternate departure flight tracks on Runway 23 only with no night runway use control
- #4 — Alternate departure flight tracks on both runways with no night runway use control
- #5 — Alternate departure flight tracks on Runway 23 only with night runway use control
- #6 — Alternate departure flight tracks on both runways with night runway use control

## 2.3 COMPARISON OF THE IMPACTS OF CURRENT AND PROJECTED OPERATIONS AND ALTERNATIVES

### 2.3.1 Changes in Aircraft Noise Levels

Sound exposure levels (SEL's) for individual aircraft operations have increased slightly as a result of the increased weight of cargo and fuel on the aircraft supporting Operations DESERT SHIELD and DESERT STORM. Increases are most significant for departure operations because the increased weight requires increased engine power levels (increasing noise emissions) and reduces climb rates, resulting in reduced altitudes and higher ground noise levels at points on the departure flight track which are near the runway. Sound exposure levels for projected operations are expected to be the same as those for equivalent current operations.

Day-Night Average Noise Levels (DNL) levels at points along the extended runway centerline have increased by more than 5 dB relative to the levels prior to Operation DESERT SHIELD while levels have decreased at points which were affected primarily by closed pattern operations on runway 05/23 or by approaches to runway 15/33. The change in DNL levels is due primarily to the initiation of night operations which are multiplied by a factor of 10 (penalized by 10 dB) in calculating the DNL.

This penalty is applied to account for the increased annoyance associated with noise events which occur at night.

The potential increase in C-5 operations from the current level of about 22 per day to 40 per day would result in further increases in the DNL in areas affected by current operations. Changes in DNL associated with projected operations are associated with the increase in the overall frequency of operations. If flight tracks and percentage utilization remain the same as for current operations, increases in DNL would be expected to be approximately 3 dB. The results of this analysis indicate that the use of alternative departure flight tracks in combination with the current night runway use mitigation procedures could reduce (Alternatives #5 and #6 as described in Section 2.2.5.5), but not eliminate, the increase in DNL levels in the areas currently affected by C-5 operations. Use of alternate flight tracks would result in overflight of new areas and would increase the noise levels in those areas. The impacts of the use of these alternative flight tracks are discussed below.

### 2.3.2 Impacts of Current and Projected Population Exposure to Aircraft Noise

#### 2.3.2.1 Annoyance

An increase in annoyance is expected to be the primary impact of the change in operations in support of Operations DESERT SHIELD and DESERT STORM and of the projected increase in operations in support of the withdrawal of forces from Southwest Asia. The level of annoyance associated with exposure to environmental noise, including aircraft noise, has been found to correlate well with the DNL. Predicted DNL levels and demographic data from the 1990 Census were used to estimate the number of persons exposed to various DNL levels. An empirical relationship between the DNL and the percentage of the exposed population characterized as "highly annoyed" (See Appendix C) was used in combination with the population exposure estimates to predict the number of persons "highly annoyed." Because the percentage of the exposed population characterized as "highly annoyed" increases exponentially as the DNL increases, the number of persons "highly annoyed" reflects both the total number of persons exposed to aircraft noise and the significance of that exposure. Table 2.1 provides a comparison of the areas and number of persons exposed to aircraft noise and the number of persons expected to be "highly annoyed" for pre-Operation DESERT SHIELD Conditions and current and projected Operation DESERT STORM operations based on the current night runway use controls (Alternative #1 as discussed in Section 2.2.5.5).

**Table 2.1** Areas and Population Exposed to DNL > 65 dB and Number of Persons "Highly Annoyed" for Aircraft Operations at Westover AFB

| Operations | Exposure to DNL > 65 dB | | No. of Persons Highly Annoyed |
|---|---|---|---|
| | Area (Sq. Mi.) | No. of Persons | |
| Prior to August 1990 (AICUZ) | 13.18 | 14,949 | 3,889 |
| Current (Jan-Mar 1991) | 13.91 | 8,841 | 2,239 |
| Projected with Runway Use Control (Alt. #1) | 19.68 | 18,385 | 4,703 |

This analysis indicates that the current (January - March 1991) operations have actually resulted in a decrease in the number of persons expected to be "highly annoyed" from about 3,900 to about 2,250, a decrease of 42 percent. This decrease is due to the reduction in the number of daily operations and the night runway use procedure which shifts the area of greatest impact to the less densely populated area to the northeast of the installation. It should be noted that this has resulted in increases of more than 5 dB in this area. The potential increase in operations to 40 per day would be expected to increase the number of persons "highly annoyed" by aircraft noise from the current level of about 2,250 to about 4,700, an increase of 110 percent relative to the current (January - March 1991) levels and 21 percent relative to the level of about 3,900 prior to initiation of Operation DESERT SHIELD.

### 2.3.2.2 Sleep Disturbance

Although sleep disturbance is a major factor in annoyance associated with exposure to noise and is thus incorporated in the analysis of the number of persons "highly annoyed" based on DNL, the potential for awakening by individual overflights was also estimated to provide a more complete basis for the identification of potential mitigation alternatives. The estimate of the number of persons awakened was based on sound exposure levels (SEL) calculated using NOISEMAP and a relationship between SEL and percent awakened developed from field and laboratory measurements (See Appendix C). As noted in the discussion in Appendix C of the relationship between SEL and awakening, there is a significant variation in the SEL values for single events. Thus, the estimates of the number of persons awakened by individual operations are most useful for comparison of the effects of various alternatives rather than as predictions of the impact of specific events.

Predicted SEL levels and population data were used to estimate the numbers of persons exposed to various exterior SEL levels by individual flight operations and the estimated numbers of persons within 5 dB exposure intervals were multiplied by the corresponding probability of awakening based on conservative estimates of attenuation by residential construction (i.e., 17 dB attenuation during summertime with windows open). The results were totaled to provide a level-weighted measure of impact analogous to the number "highly annoyed." The results of this analysis are summarized in Table 2.2.

**Table 2.2** Exposure to SEL > 95 dB and Estimated Numbers of Persons Awakened for Individual Flight Operations at Westover AFB

| Operation | No. of Persons Exposed to SEL > 95 dB | Estimated No. Awakened |
|---|---|---|
| Arrivals | | |
| Runway 05 | 29,588 | 10,927 |
| Runway 23 | 2,442 | 895 |
| Departures | | |
| Runway 05 | 3,042 | 1,263 |
| Runway 23 Straight | 33,959 | 12,347 |
| Runway 23 Left | 36,949 | 13,163 |
| Runway 23 Right | 12,415 | 4,757 |

As indicated in Table 2.2, arrivals on Runway 23 would be expected to awaken approximately 900 people while arrivals on Runway 05 would be predicted to awaken approximately 11,000 people. Departures on Runway 05 would be predicted to awaken approximately 1,300 people while departures on Runway 23 would be predicted to awaken from 4,800 to over 14,000 people, depending on the flight track used.

### 2.3.3 Impacts of Modified Operations Alternatives

To determine the potential for reduction in the noise impacts of the projected operations, the following general operational modification alternatives were evaluated:

- Continue the current night runway use control mitigation measures
- Discontinue the night runway use control to reduce impacts in the area to the northeast of the Base;
- Disperse departure operations over several flight tracks to minimize the number of overflights of specific locations; and
- Utilize a combination of preferential night runway utilization and additional flight tracks.

As discussed in Section 2.2.5.5, six specific alternatives were identified for detailed analysis. As discussed in Appendix C, the number of persons predicted to be "highly annoyed" by noise is considered to be the most appropriate basis for comparison of the noise impacts of proposed actions and was used to evaluate the relative effectiveness of these alternatives. The results of this comparison of mitigation alternatives are summarized in Table 2.3.

Based on this analysis, it is clear that continuation of the current night runway use control procedures (Alternative #1) provide a significant reduction in the level of impact relative to a return to the normal runway utilization (Alternative #2) and are more effective than dispersion of departure flight tracks used alone (Alternatives #3 and #4). The predicted reduction in the number of persons "highly annoyed" resulting from night runway use control in combination with use of alternate flight tracks for departures (Alternatives #5 and #6) indicates that the use of alternate departure flight tracks should considered for implementation.

**Table 2.3** Comparison of the Effectiveness of Mitigation Alternatives in Reducing Noise Impacts of Projected Aircraft Operations at Westover AFB

| Mitigation Alternative | | Exposure to DNL > 65 dB | | Individuals Highly Annoyed |
|---|---|---|---|---|
| No. | Description | Area ($mi^2$) | Individuals | |
| #1 | **Night Runway (RW) Use Control (Currently Used)** | **19.68** | **18,385** | **4,703** |
| #2 | Discontinue Night RW Use Control | 21.08 | 38,522 | 10,483 |
| #3 | Alt. Departure Flt. Tracks-RW 23 only | 22.72 | 35,504 | 8,917 |
| #4 | Alt. Departure Flt. Tracks-Both Runways | 22.60 | 35,406 | 8,883 |
| #5 | Night RW Use Control & Alt. Departure Tracks-Runway 23 only | 19.47 | 12,796 | 3,370 |
| #6 | Night RW Use Control & Alt. Departure Tracks-Both Runways | 21.63 | 13,301 | 3,464 |

Note: See Section 2.2.5 for description of alternatives.

# SECTION 3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

## 3.1 LOCATION, HISTORY, AND MISSION OF WESTOVER AIR FORCE BASE

### 3.1.1 Location of Westover Air Force Base

Westover Air Force (AFB) is located in Chicopee in the northern portion of Hampden County, Massachusetts. The towns of Holyoke, Ludlow, Springfield, and West Springfield in Hampden County, and Granby and South Hadley in Hampshire County adjoin or are near the base (Fig. 3.1).

### 3.1.2 History of Westover Air Force Base

Construction and activation of Westover AFB began in April 1940. During World War II, Westover served as a bomber training base and as a port of embarkation/debarkation. Following World War II, the headquarters of the Military Airlift Command (MAC) were located at Westover. In 1955, Westover became the largest SAC facility in the eastern United States with both bomber and tanker aircraft assigned. On April 1, 1974, the SAC 99th Bombardment Wing was deactivated and the installation was transferred to the Air Force Reserve (AFRES) on May 1, 1974.

Since May 19, 1974, Westover has been an Air Force Reserve base. Between 1974 and 1987, the base had a tactical airlift training mission with the 439th Tactical Airlift Wing (439TAW) operating C-123 and C-130 aircraft. In October 1987, the base assumed a strategic airlift training mission as it converted from 16 C-130E Hercules to 16 C-5A Galaxy aircraft. The 439TAW was redesignated as the 439th Military Airlift Wing (439MAW). Currently approximately 2,300 Reservists are assigned to the 439MAW at Westover AFB. Each Reservist attends training one weekend a month and performs an annual 15 day active duty tour each year. The base has a daily work force of about 1,000 civilians, including 450 Air Reserve technicians.

Tenant organizations located at Westover AFB include the Marine Corps Reserve, Army Reserve, Navy Reserve, Army National Guard, and Army Reserve School.

Following the transfer of the installation to AFRES, the 439th CSG was assigned responsibility for identifying property considered to be excess to mission requirements. The original installation encompassed an area of approximately 4700 acres. About 2300 acres have been deeded to the

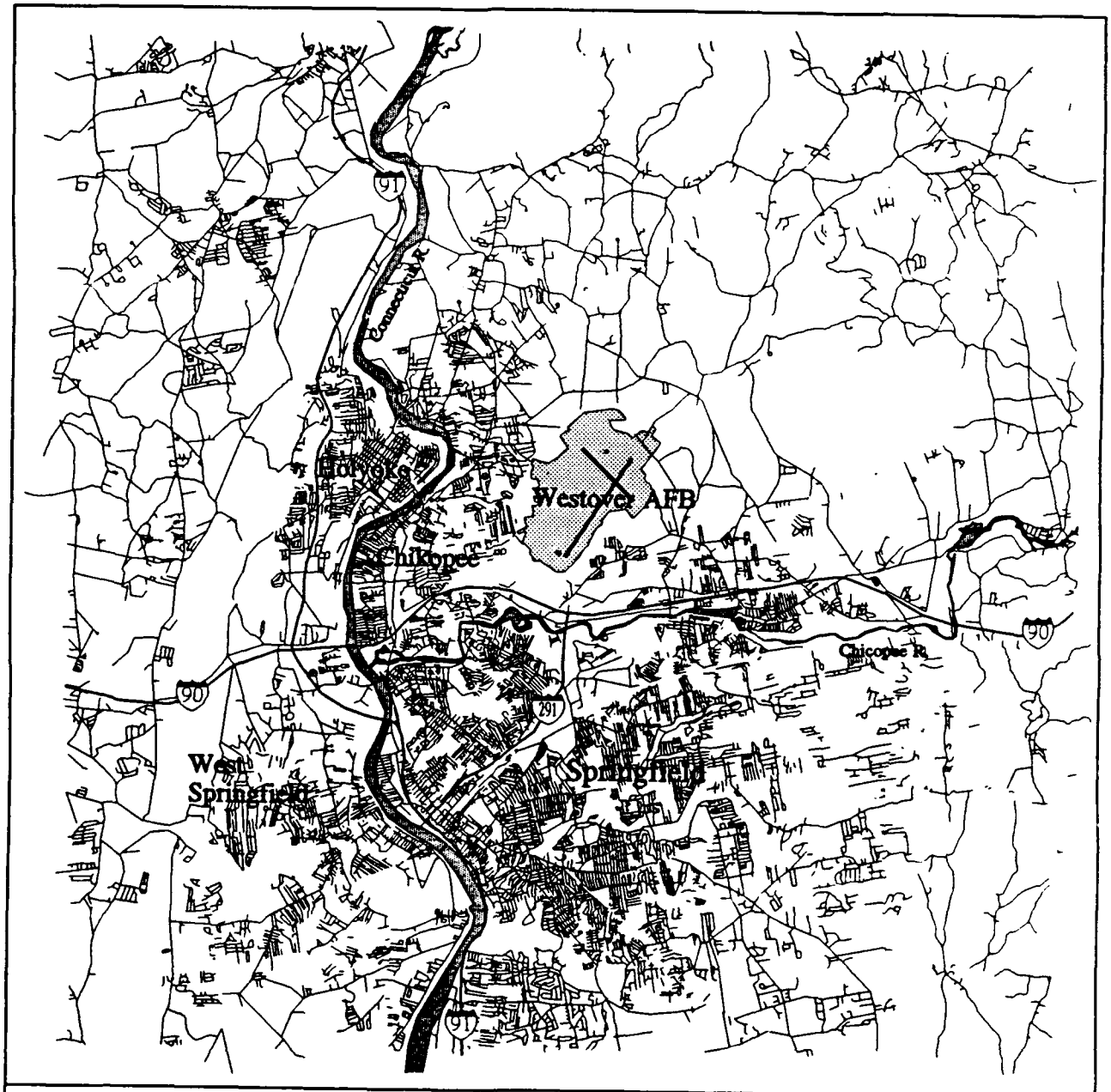


**Figure 3.1 Westover AFB and Vicinity**

surrounding townships for commercial and industrial development and for recreational use, and the base currently consists of approximately 2360 acres. Of the 2300 acres transferred to civilian ownership, approximately 1200 acres were transferred to the Westover Metropolitan Development Corporation for commercial and industrial development uses. Approximately 178 acres of the land designated for commercial development is designated as an airpark.

The WMDC is charged with the overall development of three Westover Industrial Airparks and the commercial aviation component of what is now the Westover Metropolitan Airport. Westover Metropolitan Airport is a civil aviation airfield for private, corporate, chartered, and recently, some scheduled flights. The Westover Metropolitan Airport operates in joint use with Westover Air Force Base based on an agreement signed in February 1981. Under this agreement, the Air Force controls ground and air movements of all civil aircraft. Take-offs and landings of military aircraft have priority over the operations of civil aircraft. The City of Chicopee, which is adjacent to the base, has no financial responsibility for the operation of the airport, but does have a Westover Airport Advisory Committee to review airport problems and concerns as they relate to the City.

Westover Metropolitan Airport had been the home of an Emery Air Freight International mini-hub operation from 1985 to 1990. Chicopee Air Cargo was under contract to Emery Worldwide to operate scheduled international airfreight service from the midwest to Europe. Cargo from the northeast was consolidated with cargo from the midwest for shipment to Europe on predominantly DC-8 aircraft. Return flights unloaded cargo for distribution throughout the northeast US. However, this operation ended during the summer of 1990. The airport currently has three commuter airlines operating aircraft typical of a Boeing 727, a DC-9, or a Nord 262. Commercial charter flights in the northeast using small corporate single and dual propeller aircraft also utilize the airport.

## 3.2 AIRCRAFT OPERATIONS

Aircraft operations at Westover AFB include operations by AFRES C-5A aircraft and Massachusetts Army National Guard (ANG) UH-1 helicopters based at Westover, general aviation aircraft based at the WMDC facilities, and transient military and civil aircraft. Transient military activity includes operations by A-10, B-52, C-130, F-15 and P-3 aircraft; civil aircraft activity includes operations by B-727, DC-9 and other commercial aircraft in addition to one and two engine general aviation aircraft. Appendix D includes detailed information on the aircraft operations at Westover AFB prior to the initiation of operations in the gulf region.

### 3.2.1 Operations Prior to Operation DESERT SHIELD

Prior to the Iraqi invasion of Kuwait and the initiation of Operation DESERT SHIELD, most C-5A aircraft operations were conducted to assure that pilots attain and maintain required proficiency standards. Local flying training was limited to an average of 20 hours per week and local training sorties were normally scheduled for three or four days per week. No operations were scheduled after 10 p.m. local time.

To maintain required standards, an average of 14 local training sorties are required each month. Each sortie consists of a takeoff and landing plus approximately 31 closed pattern operations which may involve either a "touch-and-go" landing in which the aircraft touches down on the runway and then immediately departs without coming to a stop or a low approach in which the aircraft descends as if preparing to land and departs as if taking off, but does not touch down on the runway.

Due to the prevailing wind conditions, Runway 23 is used for approximately 80 percent of the operations, resulting in approaches from the northeast over Granby and departures to the southwest over Chicopee and Springfield.

### 3.2.2 Operations in Support of Operation DESERT STORM

Support of Operations DESERT SHIELD and DESERT STORM has reduced the number of C-5 aircraft operations[5] at Westover AFB from the previous level of approximately 68 per flying day or 220 per week to approximately 150 per week. Prior to initiation of Operation DESERT SHIELD, local flying training was limited to 20 hours per week and local training was typically conducted three or four days per week. Operations in support of DESERT STORM are conducted 24-hours a day, 7 days a week.

Following the initiation of Operation DESERT SHIELD, MAC suspended all pilot currency training requirements, resulting in the virtual elimination of local training sorties and associated closed pattern operations at Westover AFB. Aircraft supporting operations in the gulf utilize instrument approaches and maintain runway heading on departure until approximately 5 miles from the base. As indicated in Figure 3.2, support for operation DESERT SHIELD and DESERT STORM has resulted in a slight decrease in the monthly average number of operations at Westover AFB.

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[5]An operation is defined as either an arrival or a departure; touch-and-go operations conducted during training flights count as two operations.

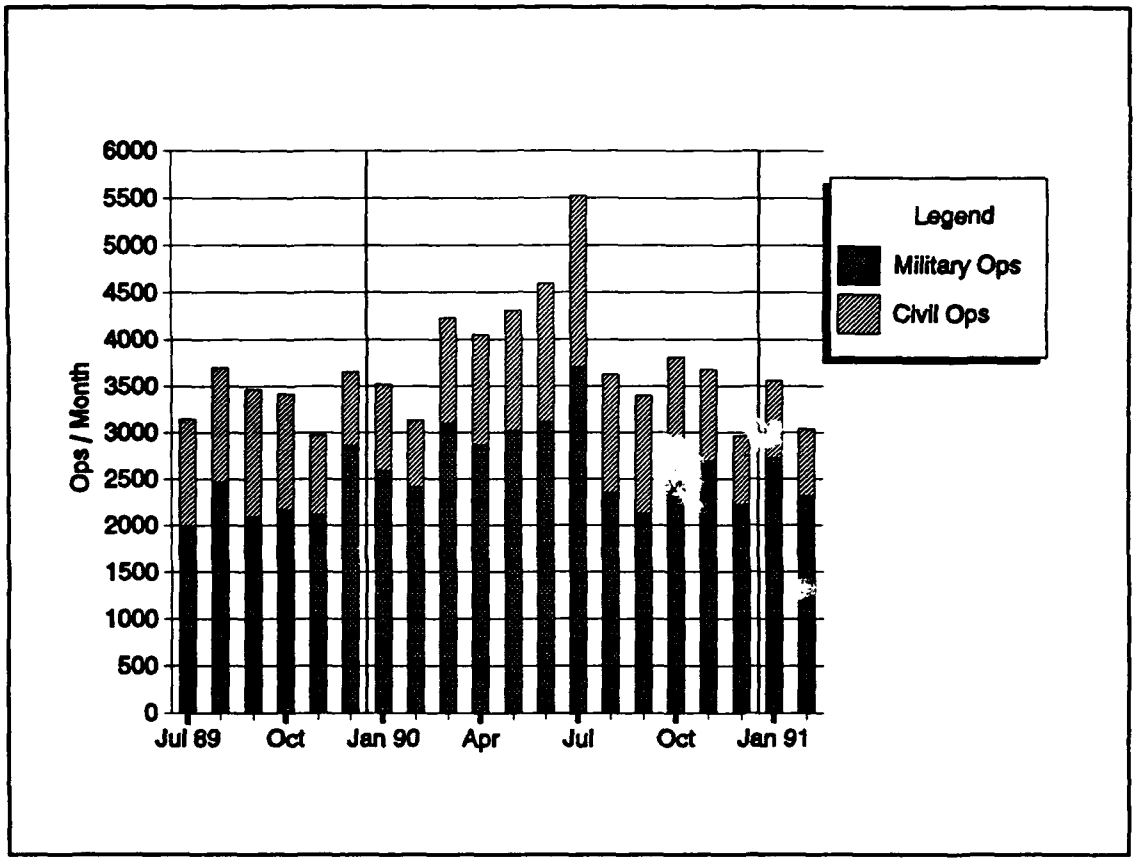


**Figure 3.2** Aircraft Operations at Westover AFB, July 1989 to March 1991

Westover AFB has maintained detailed records of aircraft operations in support of Operations DESERT SHIELD and DESERT STORM. During the period from August 7, 1990 through March 27, 1991, a total of 4426 support operations were recorded. The majority of these operations were by C-5 aircraft; C-141, C-130 and other aircraft have also utilized Westover AFB as an intermediate stopping point in support of operations in the Persian Gulf. Table 3.1 summarizes the aircraft operations in support of Operations DESERT SHIELD and DESERT STORM. Figure 3.3 illustrates the variation in daily C-5 aircraft operations for the period January 1 through March 27, 1991.

Prior to Operation DESERT SHIELD, operations at Westover AFB were normally completed prior to 10 p.m. and there were essentially no operations between 10 p.m. and 7 a.m. With the initiation of Operation DESERT SHIELD, tower operations were extended to 24-hours per day and aircraft arrive and depart throughout the entire 24-hour day. An analysis of the operations between January and March of 1991 indicated that approximately 35 percent of the operations occurred between 10 p.m. and 7 a.m. (if distribution of operations had been perfectly uniform, nine twenty-fourths or 37.5

**Table 3.1** Summary of Aircraft Operations at Westover AFB in Support of Operations Desert Shield and Desert Storm

| | Operation Desert Shield/Desert Storm Aircraft Operations | | | | |
|---|---|---|---|---|---|
| Month | C-5 | C-141 | C-130 | Other | Total |
| August 90 | 179 | 4 | 92 | 0 | 275 |
| September | 334 | 12 | 56 | 0 | 402 |
| October | 501 | 5 | 19 | 4 | 529 |
| November | 382 | 20 | 25 | 5 | 432 |
| December | 529 | 24 | 38 | 1 | 592 |
| January | 658 | 24 | 53 | 5 | 740 |
| February | 614 | 16 | 69 | 2 | 701 |
| March | 509 | 12 | 225 | 9 | 755 |
| Totals: | 3706 | 117 | 577 | 26 | 4,426 |

percent of the operations would have occurred during these hours.)

In an effort to minimize the number of persons disturbed by night operations, Westover AFB has initiated a noise mitigation program in which pilots are requested to utilize runway 23 for arrival and runway 05 for departure between 11 p.m. and 7 a.m. whenever the wind conditions permit[6]. Air traffic control personnel at Westover estimate that the preferred runways are used for more than 90 percent of the operations between 11 p.m. and 7 a.m.

[6]Military Airlift Command (MAC) Regulation 55-2, *C-5 Airlift Operations*, regulations requires a change in runway whenever tailwinds (i.e., the component of the wind speed parallel to the runway in the direction of aircraft movement) exceeds 10 knots. An analysis of wind speeds and directions conducted during preparation of the 1987 EIS indicated that the preferred runways could be used more than 90 percent of the time.

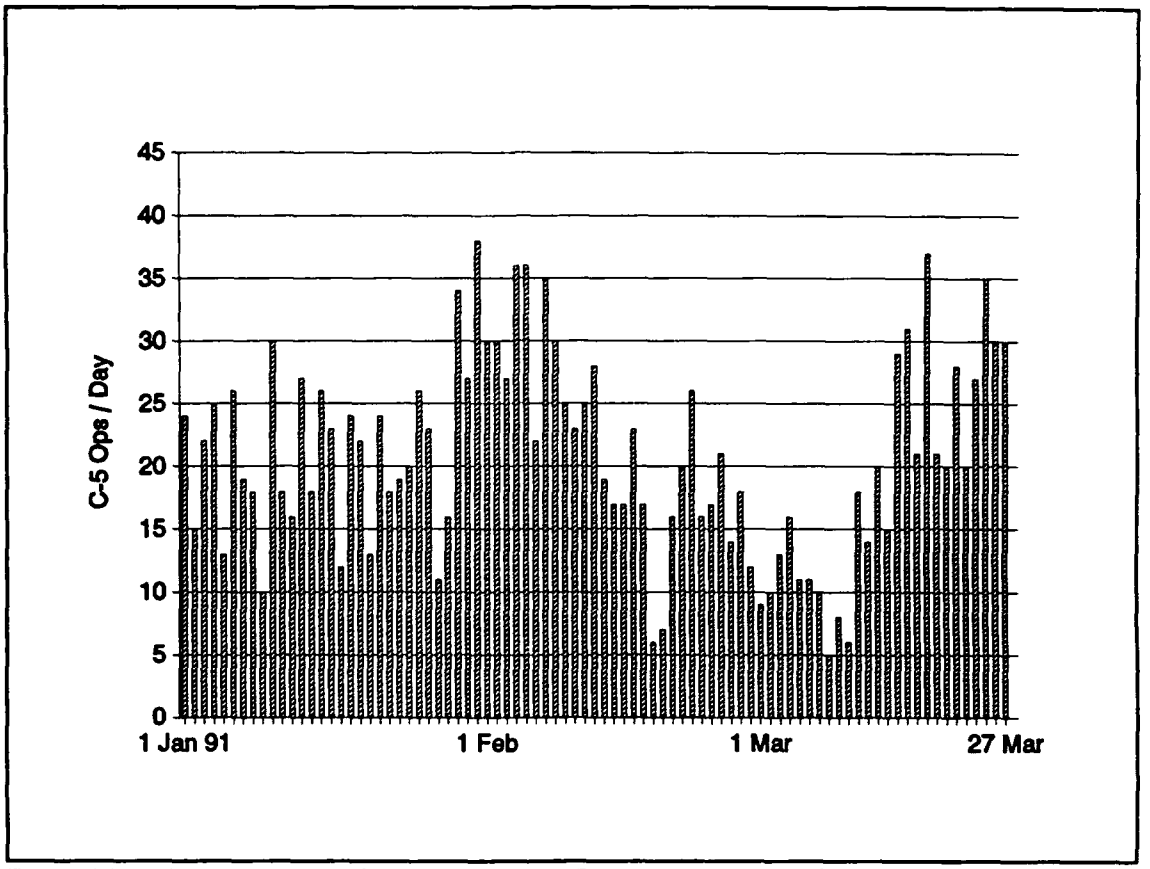


**Figure 3.3** C-5 Support Operations at Westover AFB - January to March 1991

## 3.3 NOISE

Noise associated with the activities at Westover AFB is characteristic of that associated with most Air Force installations with flying operations. During periods of no aircraft activity, noise associated with base operations results primarily from maintenance and shop activities, ground traffic movement, occasional construction and similar sources. The resultant noise is almost entirely restricted to the base itself and is comparable to that which might occur in adjacent community areas. It is only during periods of aircraft ground or flight activity that the situation changes.

Aircraft noise as well as most other types of environmental noise, is measured on the A-weighted decibel scale. The A-weighted scale de-emphasizes the low- and high-frequency portions of the sound spectrum and provides a good approximation of the response of the average young, undamaged human ear. The A-weighted scale correlates well with the average person's judgement of

the relative loudness of a noise event (EPA 1974). The decibel is a logarithmic scale on which an increase of 3 dB represents a doubling of sound energy. In reality, a 3 dB difference in noise levels is only moderately detectable by the human ear. A difference on the order of 10 dB represents a subjective doubling of loudness. Thus, a 3 dB difference corresponds to a doubling in sound energy, while a 10 dB difference corresponds approximately to a doubling in the subjective loudness (USAF 1978). A more detailed description of noise metrics is provided in Appendix B.

Environmental noise levels resulting from aircraft operations are most frequently described in terms of the average day/night sound level (DNL y-avg) values. The DNL is the noise level averaged on an energy basis over a period of 24 hours, with a 10 Db penalty applied to nighttime (10 p.m. to 7 a.m.) sound levels to account for increased annoyance by noise during the night hours (Newman and Beattie 1985). The annual average DNL (DNL y-avg) provides the basis for the land-use compatibility guidelines in the Air Force's Air Installation Compatible Use Zone (AICUZ) program (USAF 1984). The DNL value is also used by the U.S. Environmental Protection Agency, the U.S. Department of Housing and Urban Development, the Federal Aviation Administration, and the Veterans Administration to describe noise exposure and predict the effects on humans of long-term exposure to environmental noise. DNL values are expressed on the A-weighted decibel scale.

The NOISEMAP computer program developed by the Air Force is used to describe the noise environment in the vicinity of Air Force installations. Data describing the flight tracks, altitude profiles, power settings, aircraft speeds and frequency of aircraft flight operations and the location, duration and power settings of ground runup operations by type of aircraft are provided as inputs to the program. The program uses this information in combination with databases on aircraft noise levels and information on local conditions to predict DNL levels at points on a regularly spaced 100x100 point grid surrounding the installation. This grid data is then used to produce contours which show the locations of points on the ground having equal DNL levels. Contours are normally produced for 5 dB DNL intervals beginning at 65 dB DNL, the maximum level considered acceptable for unrestricted residential land use.

### 3.3.1 Noise Levels Prior to Operation DESERT SHIELD

Figure 3.4 depicts the DNL contours for the normal training operations which occurred prior to the initiation of Operation DESERT SHIELD as indicated in the Air Installation Compatible Use Zone (AICUZ) study issued in 1990 (USAF 1990). These contours are representative of the annual average DNL levels on average busy days on which a local training sortie is flown. The contours are

based on the annual average runway utilization with 80 percent of the operations on runway 23 and 20 percent on runway 05.

To provide an estimate of the number of persons exposed to DNL levels above 65 dB, the Geographical Resources Analysis Support System (GRASS) geographic information system developed by the U.S. Army Corps of Engineers Construction Engineering Research Laboratory (CERL) was utilized to overlay the noise contours produced by NOISEMAP on the U.S. Geological Survey's TIGER (Topologically Integrated Geographic Encoding and Referencing) system line files which delineate the census blocks and combined with the 1990 census data to provide estimates of the population within each contour interval. The results of this analysis are shown in Table 3.2 which indicates the area and number of persons exposed to DNL > 65 dB for operations prior to initiation of Operation DESERT SHIELD.

**Table 3.2** Areas Exposed to DNL > 65 dB for Previous and Current Aircraft Operations at Westover AFB

| | Previous Operations (1990 AICUZ) | | Current Operations (Jan-Mar 1991) | |
|---|---|---|---|---|
| DNL Interval | Area ($mi^2$) | No. of Persons | Area ($mi^2$) | No. of Persons |
| 65-70 | 6.53 | 10,005 | 7.38 | 6,415 |
| 70-75 | 3.21 | 4,217 | 3.55 | 1,760 |
| 75-80 | 1.87 | 115 | 1.44 | 535 |
| >80 | 1.58 | 612 | 1.54 | 131 |
| Totals: | 13.18 | 14,949 | 13.91 | 8,841 |

### 3.3.2 Noise Levels for Current Operations.

To provide an estimate of the current noise levels associated with operations in support of forces in the gulf, the NOISEMAP program was used to estimate the DNL levels resulting from the support operations for the period from January 1 through March 27, 1991 (see Section 3.1) in combination with the same levels of transient military and civil aviation operations used in the AICUZ study. The DNL contours associated with the current support operations are shown in Figure 3.5. DNL contours for the C-5 operations and transient military and civilian aircraft operations alone are provided in Appendix D. Comparison of these contours (Figures D.1 and D.2) with Figure 3.5 indicates that C-5

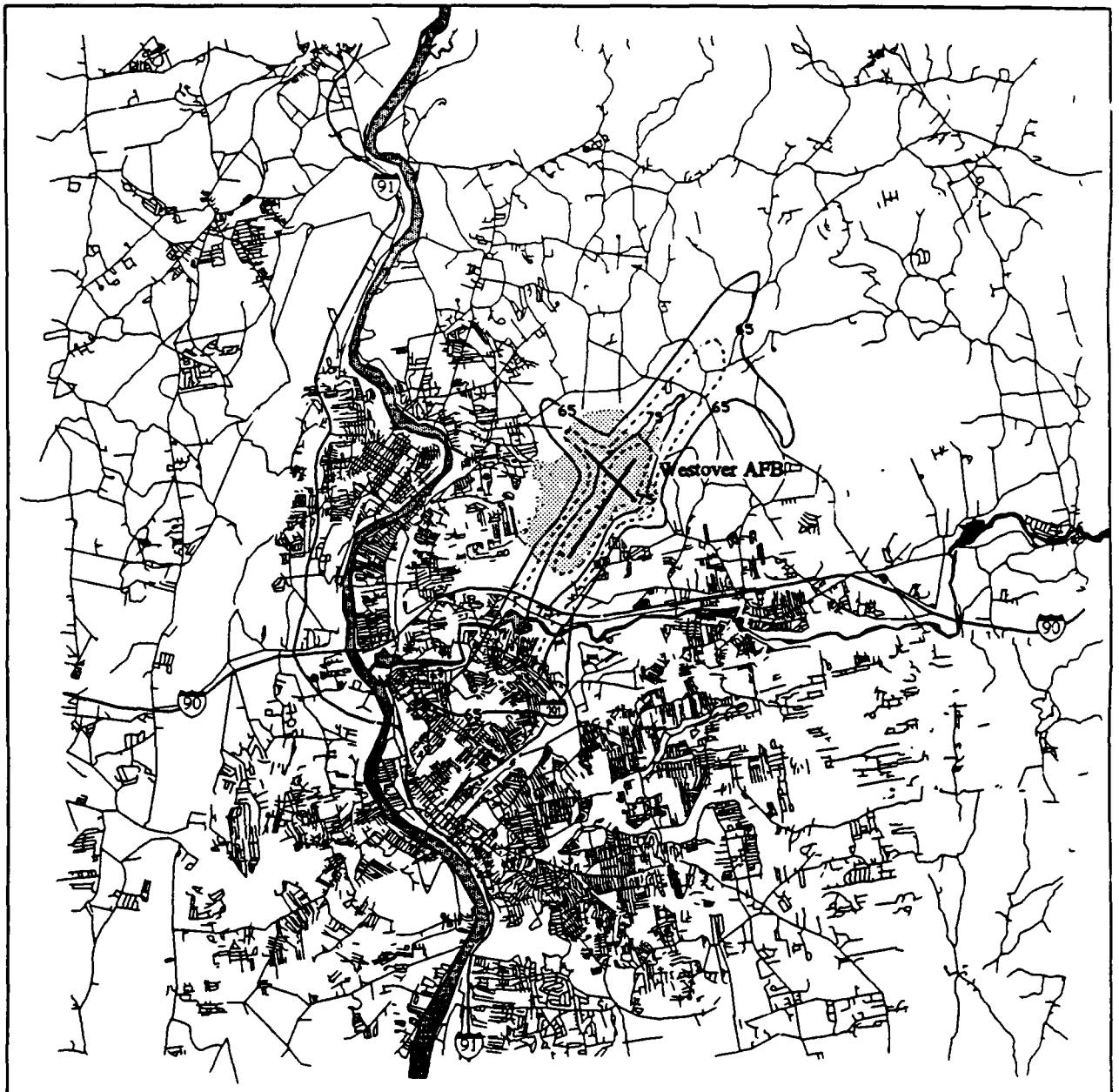


**Figure 3.4** DNL Contours for Aircraft Operations at Westover AFB, MA Prior to Operations Desert Shield and Desert Storm

operations are the dominant noise source at Westover AFB and noise impacts resulting from changes in transient military operations not related to support for forces in the gulf or changes in civil aviation operation would be insignificant in relation to the impacts of C-5 operations and, therefore, were not investigated in this analysis.

Table 3.2 also provides an estimate of the areas and numbers of residents within the various contour intervals for current operations. As noted in Table 3.2, the current operations have actually resulted in a decrease in the number of persons exposed to DNL levels > 65 dB. Although the reduction in the number of operations is offset by the initiation of night operations, the night runway use procedure shifts the impact to the area to the northeast of the installation where the population density is lowest (compare Figures 3.4 and 3.5).

### 3.3.3 Noise Impacts of Current Operations

The impacts of current noise levels are discussed in Section 4.2.

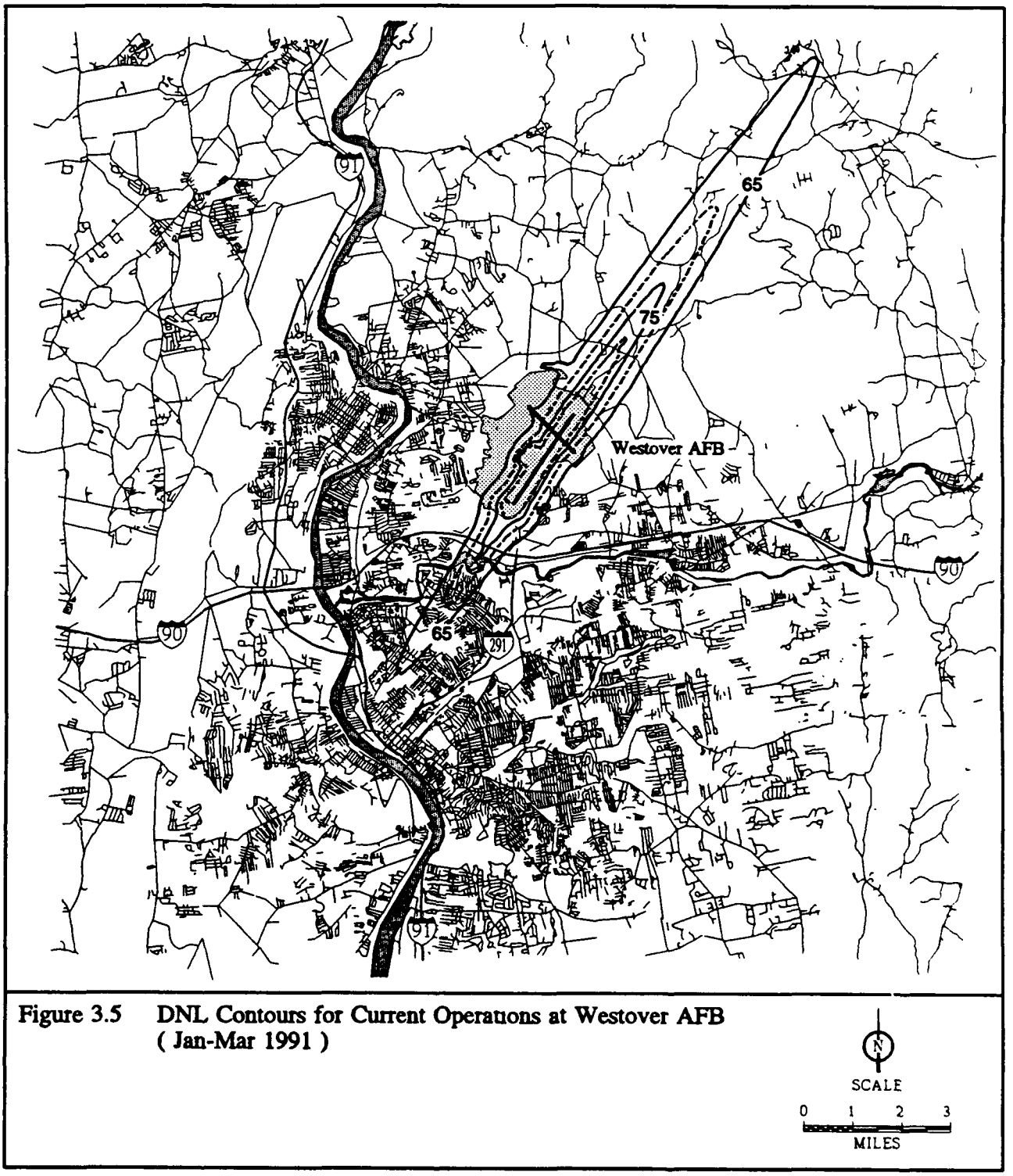


**Figure 3.5** DNL Contours for Current Operations at Westover AFB ( Jan-Mar 1991 )

# SECTION 4 IMPACT OF THE PROJECTED AIRCRAFT OPERATIONS

In accordance with the CEQ request (Appendix A), this Special Environmental Assessment is focused on noise impacts only and potential impacts, such as those associated with air emissions, waste water, or hazardous and non-hazardous waste generation, are not evaluated.

## 4.1 AIRCRAFT OPERATIONS

As discussed in Section 2, TRANSCOM anticipates that the number of C-5 operations may increase for periods of time to a level of 40 per day (20 arrivals and 20 departures) and will continue to be approximately uniformly distributed throughout the 24-hour day. For purposes of analyzing the noise impacts of the projected operations, it was assumed that there would be 40 C-5 operations per day, the level of non-C-5 support operations (i.e., C-141 and C-130 operations) remains at the level which occurred between January and March of 1991, and that other aircraft operations remain at the levels analyzed in the AICUZ study (See Appendix D, Table D.1).

## 4.2 NOISE

### 4.2.1 Noise-Related Issues Identified for Analysis

Potential impacts associated with exposure to aircraft noise include:

- annoyance
- speech interference
- conflicts with existing land uses
- restraints on future land uses
- sleep disturbance
- hearing loss
- effects on domestic animals and wildlife
- health effects other than hearing loss, and
- reduction in property values.

Each of these potential impacts was considered in the development of this analysis. Based on a review of applicable literature, the predicted noise levels, and the temporary nature of the current and

projected operations in support of Operation DESERT STORM, it was concluded that the only potentially significant impacts are annoyance and sleep disturbance and only these issues are addressed in this analysis. Although both speech interference and sleep disturbance are important factors in the annoyance associated with noise exposure, the reduction in the number of operations and the fact that many of the operations will occur between the hours of 10 p.m. and 7 a.m. would be expected to result in a reduction in speech interference.

Because the increase in operations is temporary, impacts on property values or current and future land uses are not expected to be significant; however, the increase in noise levels does serve to emphasize the importance of land use controls to prevent incompatible land development in the vicinity of flying installations. Although the change in operations has resulted in an increase in the DNL level in areas surrounding the base, the increase is due to the initiation of night operations and the effect of the 10 dB penalty applied to these operations. The 24-hour equivalent noise levels (i.e., the average noise levels without application of the 10 dB penalty for night operations) for both current and projected operations are actually lower than the levels associated with operations prior to initiation of Operation DESERT SHIELD. Therefore, the change in operations would not be expected to result in any increase in potential for hearing loss or non-auditory health effects not associated with annoyance. Similarly, no impacts to either wild or domestic animals would be expected to result from the change in the timing of operations.

### 4.2.2 Noise Impacts of Projected Operations

#### 4.2.2.1 Projected Noise Levels

The NOISEMAP program was used to predict the DNL levels expected to result from the projected increase in C-5 operations; the DNL contours for the projected operations are shown in Figure 4.1.

#### 4.2.2.2 Population Exposure to Aircraft Noise

The areas and numbers of residents exposed to DNL levels above 65 dB were estimated using the same techniques used to estimate the area and population exposures for the pre-Operation DESERT SHIELD and current operations and the results are summarized in Table 4.1. This table also indicates the areas and populations exposed by operations prior to initiation of Operation DESERT SHIELD for comparison.


**Figure 4.1** Day-Night Average Noise Level (DNL) Contours for Projected Aircraft Operations at Westover AFB with Runway Utilization Mitigation ( Alternative #1 )

#### 4.2.2.3 Effects of Noise Exposure

Annoyance is the primary human response to environmental noise, including aircraft noise, and the degree of annoyance has been found to correlate well with the DNL (See Appendix C). As discussed in Appendix C, the relationship between the DNL and the percentage of the exposed population characterized as "highly annoyed" was used in combination with the estimated population exposed to DNL levels > 65 dB to estimate the number of persons "highly annoyed" by aircraft noise for the operations prior to initiation of Operation DESERT SHIELD and current (January to March 1991) and projected support operations at Westover AFB. The results of these estimates are also shown in Table 4.1.

**Table 4.1** Comparison of DNL Exposures and Annoyance for Aircraft Operations at Westover AFB

| | Previous Operations (1990 AICUZ) | | | Current Support Operations (Jan-Mar 91) | | | Projected Support Operations | | |
|---|---|---|---|---|---|---|---|---|---|
| | Exposure to DNL > 65 dB | | | Exposure to DNL > 65 dB | | | Exposure to DNL > 65 dB | | |
| DNL Interval | Area ($mi^2$) | No. of Persons | No. Highly Annoyed | Area ($mi^2$) | No. of Persons | No. Highly Annoyed | Area ($mi^2$) | No. of Persons | No. Highly Annoyed |
| 65-70 | 6.53 | 10,005 | 2,101 | 7.38 | 6,415 | 1,347 | 9.67 | 13,165 | 2,765 |
| 70-75 | 3.21 | 4,217 | 1,349 | 3.55 | 1,760 | 563 | 5.53 | 4,015 | 1,285 |
| 75-80 | 1.87 | 115 | 53 | 1.44 | 535 | 246 | 2.22 | 620 | 285 |
| >80 | 1.58 | 612 | 386 | 1.54 | 131 | 83 | 2.26 | 585 | 369 |
| Totals | 13.18 | 14,949 | 3,889 | 13.91 | 8,841 | 2,239 | 19.68 | 18,385 | 4,703 |

As indicated in Table 4.1, the current (January - March 1991) operations have actually resulted in a decrease in the number of persons expected to be "highly annoyed" from about 3,900 to about 2,250, a decrease of 42 percent. This decrease is due to the reduction in the number of daily operations and the night runway use procedure which shifts the area of greatest impact to the less densely populated area to the northeast of the installation. It should be noted that this has resulted in increases of more than 5 dB in this area. The potential increase in operations to 40 per day would be expected to increase

the number of persons "highly annoyed" by aircraft noise from the current level of about 2,250 to about 4,700, an increase of 110 percent relative to the current (January - March 1991) levels and 21 percent relative to the level of about 3,900 prior to initiation of Operation DESERT SHIELD.

In evaluating the level of annoyance expected to result from exposure to aircraft noise, it must be pointed out that the relationship between DNL and percent highly annoyed used in this analysis (Appendix C) is based on long-term exposure and that annoyance is influenced by many factors, including habituation and attitude toward the activity creating the noise. Since the base is scheduled to demobilize by July 15, 1991, any changes from the current conditions will be short-term. Variations from the predicted percent highly annoyed could be expected due to two offsetting factors: residents will not have sufficient time to habituate to the noise and there may be a positive bias response in favor of the operations that support the return of U.S. forces.

Sleep disturbance is a major factor in annoyance associated with exposure to aircraft noise and is thus included in the relationship between DNL and the number of persons highly annoyed by aircraft noise. To provide a more detailed analysis of the sleep disturbance impacts of current and proposed aircraft operations and the effectiveness of mitigation measures, an empirical relationship between SEL and the percent of exposed persons awakened was used to estimate the numbers of persons likely to be awakened by a single aircraft operation. The estimate of the number of persons awakened was based on sound exposure levels (SEL) calculated using NOISEMAP and a relationship between SEL and percent awakened developed from field and laboratory measurements (See Appendix C). As noted in the discussion of the relationship between SEL and awakening, there is a significant variation in the SEL values for single events. Thus, the estimates of the number of persons awakened by individual operations are most useful for comparison of the effects of various types of operations rather than as predictions of the impact of specific events. The NOISEMAP program output was combined with population data in a manner similar to that used to estimate the population exposure to DNL values above 65 dB to provide estimates of the number of persons exposed to exterior SEL values above 95 dB in 5 dB increments. The number of persons exposed was multiplied by the average percent awakened for each SEL increment (based on average summertime noise attenuation levels of 17 dB for cold climate residential construction with windows open) and the results were totaled to provide an estimate of the number of persons predicted to be awakened by a single event. The results of this analysis are summarized in Tables 4.2.

As indicated in Table 4.2, the greatest numbers of persons would be expected to be awakened by departures on Runway 23 (12,347 persons) and arrivals on Runway 05 (10,297 persons). Departures

**Table 4.2** Comparison of Probable Awakenings for Night Operations at Westover AFB

| Outdoor SEL Range | Percent Awakened | Arrival on Runway 05 | | Arrival on Runway 23 | |
|---|---|---|---|---|---|
| | | Persons Exposed | Number Awakened | Persons Exposed | Number Awakened |
| 95-100 | 33.2 | 19,211 | 6,391 | 1,734 | 577 |
| 100-105 | 41.0 | 7,705 | 3,161 | 487 | 200 |
| 105-110 | 50.0 | 2,300 | 1,150 | 158 | 79 |
| 110-115 | 60.3 | 365 | 220 | 53 | 32 |
| 115-120 | 72.0 | 7 | 5 | 10 | 7 |
| Totals: | | 29,588 | 10,927 | 2,442 | 895 |

| Outdoor SEL Range | Percent Awakened | Departure on Runway 05 | | Departure on Runway 23 | |
|---|---|---|---|---|---|
| | | Persons Exposed | Number Awakened | Persons Exposed | Number Awakened |
| 95-100 | 33.2 | 1,493 | 497 | 23,890 | 7,948 |
| 100-105 | 41.0 | 706 | 290 | 7,685 | 3,152 |
| 105-110 | 50.0 | 390 | 195 | 1,936 | 968 |
| 110-115 | 60.3 | 383 | 231 | 371 | 224 |
| 115-120 | 72.0 | 70 | 50 | 77 | 55 |
| Totals: | | 3,042 | 1,263 | 33,959 | 12,347 |

on Runway 05 would be predicted to awaken approximately 1,263 persons and arrivals on Runway 23 would be expected to awaken only about 895 persons. As noted in Appendix C, there is a significant variation in the SEL values for individual operations and predictions of the number of persons awakened are most useful for comparison of the relative impacts of the various alternatives rather than as predictions of the specific impacts of individual noise events. It must also be noted that these figures are for single operations only and do not provide estimates of the total number of persons who might be awakened during a single night or the number of persons awakened by more than one operation.

The comparison between the number of persons affected by operations on Runway 05 versus Runway 23 indicates that the night runway utilization procedures currently implemented by Westover AFB are effective in reducing the number of persons affected by night operations. However, it must

also be noted that, because of their proximity to the runway, persons living to the northeast of the Base (i.e., under the approach to Runway 23/departure for Runway 05 in Acrebrook subdivision and along East Street in Granby) would be expected to be awakened by most, if not all, of the night operations and the night runway use procedures increase the number of operations affecting this area.

### 4.2.3 Noise Impacts of Potential Mitigation Alternatives

As noted in Section 3.1, Westover has initiated a system of preferential runway utilization (i.e., landings on Runway 23 and departures on Runway 05) during the time period from 11 p.m. to 7 a.m. in an effort to minimize the number of persons disturbed by night operations. Although the analysis discussed above indicates that this approach does effectively reduce the number of persons affected by night operations, the CEQ requested that additional mitigation alternatives, including the use of alternative flight patterns (tracks), be evaluated. In accordance with this request, the feasibility of using alternate flight tracks to reduce population exposure to aircraft noise was evaluated. Because the majority of aircraft operations in support of Operation DESERT STORM are by transient aircraft, the instrument landing system is used for essentially all arrivals and the use of alternate flight tracks in the vicinity of the Base was not considered feasible.

The use of alternate departure flight tracks was considered feasible. Air Force Manual 51-27, *Instrument Flying*, prohibits initiation of turns by departing C-5 aircraft at altitudes below 400 feet AGL. To provide a margin of safety, the departing aircraft were assumed to initiate a turn of approximately 40° at an altitude of 600 feet AGL (approximately over the end of the runway). Because of the loading of the aircraft, a turn radius of 12,000 feet was assumed.

A discussed in Section 2.2.5, a total of six alternatives for conduct of projected C-5 stage operations were identified for detailed analysis of noise impacts:

- #1 — Continue the current night runway use controls
- #2 — Discontinue night runway use control
- #3 — Alternate departure flight tracks on Runway 23 only with no night runway use control
- #4 — Alternate departure flight tracks on both runways with no night runway use control
- #5 — Alternate departure flight tracks on Runway 23 only with night runway use control
- #6 — Alternate departure flight tracks on both runways with night runway use control

Analysis of the use of dispersed departure flight tracks on Runway 05 indicated that because the noise environment in the area close to the northeast end of the runway (the approach to Runway 23) is dominated by C-5 arrivals, the use of dispersed departure tracks increased the area exposed to DNL > 65 dB in the area near the base and results in only a small decrease in the area along the runway centerline. Therefore, the use of dispersed flight tracks for departures on Runway 05 alone was not considered feasible. The use of alternate departure flight tracks on Runway 23 alone and on both Runway 23 and 05 was determined to offer potential for reducing the number of exposed to DNL > 65 dB and was investigated. To provide an estimate of the relative effectiveness of various mitigation alternatives, the population exposure and number of persons highly annoyed was estimated for operations based on the normal 80 percent utilization of Runway 23 with departures and arrivals on the runway heading.

Table 4.3 provides a summary of the results of this comparative analysis and the DNL contours are illustrated in Figures 4.2 through 4.6 (DNL contours for the projected operations with preferential runway utilization were shown on Figure 4.1).

The results of this analysis indicate that the current night runway use control (Alternative #1) is more effective than the use of alternate departure flight tracks (Alternatives #3 and #4) alone; however, the use of the two measures in combination (Alternatives #5 and #6) has the potential to further reduce the population exposed to DNL > 65 dB and should be considered for implementation to the degree practicable. Although the comparison in Table 4.3 indicates that use of alternate flight tracks for operations on both runways (Alternative #6) would result in slightly greater impacts than the use of alternative flight tracks for operations on Runway 23 only (Alternative #5), the small differences between the predicted impacts for Alternatives #5 and #6 are not considered statistically significant. Use of alternate flight tracks for departures on Runway 05 would not significantly reduce the disturbance to persons living in the area of maximum impact immediately northeast of the threshold of runway 23 (i.e., in Acrebrook subdivision and along East Street in Granby).

The potential for reducing sleep disturbance in areas south of the base through the use of alternate flight tracks was also evaluated. The populations exposed to SEL > 95 dB and the predicted numbers of persons awakened by single operations on alternate departure flight tracks for Runway 23 are compared in Table 4.4. Comparison of the data in this table and that in Table 4.2 for straight departures indicates that, when operating on Runway 23, use of departure flight tracks which incorporate a right turn immediately after departure could reduce the number of people exposed to exterior SEL > 95 dB from more than 30,000 to less than 12,500. Use of alternate flight tracks is subject to aircraft

**Table 4.3** Effectiveness of Mitigation Alternatives for Projected Operations at Westover AFB

| DNL Level (dB) | Exposure | | Impact |
|---|---|---|---|
| | Area ($mi^2$) | Number of Persons | Number Highly Annoyed |
| **#1 — Continue Night Runway Use Control (Current Mitigation Measures) - Figure 4.1** | | | |
| 65-70 | 9.67 | 13,165 | 2,765 |
| 70-75 | 5.53 | 4,015 | 1,285 |
| 75-80 | 2.22 | 620 | 285 |
| >80 | 2.26 | 585 | 369 |
| Totals: | 19.68 | 18,385 | 4,703 |
| **#2 — Discontinue Night Runway Use Control (80% of Operations on Runway 23) - Figure 4.2** | | | |
| 65-70 | 10.96 | 22,932 | 4,816 |
| 70-75 | 5.31 | 11,585 | 3,707 |
| 75-80 | 2.54 | 3,311 | 1,523 |
| >80 | 2.27 | 694 | 437 |
| Totals: | 21.08 | 38,522 | 10,483 |
| **#3 — Use Alternate Departure Flight Tracks on Runway 23 Only - Figure 4.3** | | | |
| 65-70 | 12.96 | 26,273 | 5,517 |
| 70-75 | 5.27 | 6,683 | 2,139 |
| 75-80 | 2.33 | 2,024 | 931 |
| >80 | 2.16 | 524 | 330 |
| Totals: | 22.72 | 35,504 | 8,917 |
| **#4 — Use Alternate Departure Flight Tracks on Both Runways - Figure 4.4** | | | |
| 65-70 | 13.20 | 26,228 | 5,508 |
| 70-75 | 4.95 | 6,580 | 2,106 |
| 75-80 | 2.26 | 2,014 | 926 |
| >80 | 2.19 | 524 | 330 |
| Totals: | 22.60 | 35,346 | 8,870 |
| **#5 — Night Runway Use Control with Alternate Departure Flight Tracks on Runway 23 Only - Figure 4.5** | | | |
| 65-70 | 9.67 | 8,811 | 1,850 |
| 70-75 | 5.39 | 2,950 | 944 |
| 75-80 | 2.15 | 450 | 207 |
| >80 | 2.26 | 585 | 369 |
| Totals: | 19.47 | 12,796 | 3,370 |
| **#6 — Night Runway Use Control with Alternate Departure Flight Tracks on Both Runways - Figure 4.6** | | | |
| 65-70 | 12.24 | 9,395 | 1,973 |
| 70-75 | 5.14 | 2,877 | 921 |
| 75-80 | 2.10 | 457 | 210 |
| >80 | 2.15 | 572 | 360 |
| Totals: | 21.63 | 13,301 | 3,464 |


**Figure 4.2** DNL Contours for Projected Aircraft Operations at Westover AFB without Mitigation ( Alternative #2 )


**Figure 4.3** DNL Contours for Projected Aircraft Operations at Westover AFB with Use of Alternate Flight Tracks for Departures on Runway 23 ( Alternative #3 )


Figure 4.4 DNL Contours for Projected Aircraft Operations at Westover AFB with Use of Alternate Flight Tracks on Both Runways ( Alternative #4 )


**Figure 4.5** DNL Contours for Projected Aircraft Operations at Westover AFB with Runway Utilization and Alternate Departure Tracks on Runway 23 ( Alternative #5 )

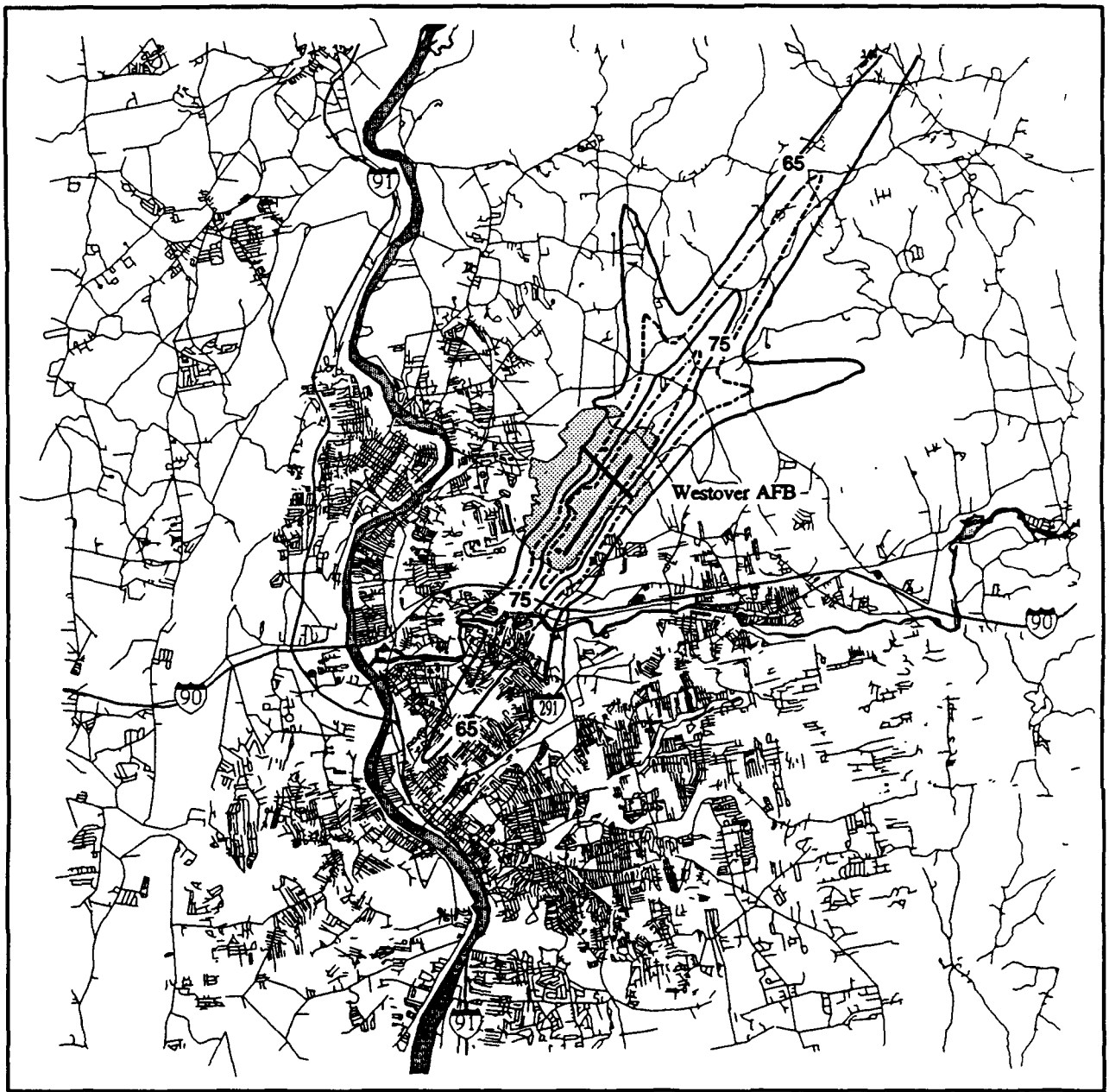


Figure 4.6 DNL Contours for Projected Aircraft Operations at Westover AFB with Runway Utilization and Use of Alternate Departure Tracks on Both Runways ( Alternative #6 )

safety requirements and air traffic control requirements which may limit the utilization of alternate flight tracks.

**Table 4.4** Comparison of Probable Awakenings for Departures on Alternate Flight Tracks from Runway 23 for Night Operations at Westover AFB

| Outdoor SEL Range | Percent Awakened | Departure with Left Turn | | Departure with Right Turn | |
|---|---|---|---|---|---|
| | | Persons Exposed | Number Awakened | Persons Exposed | Number Awakened |
| 95-100 | 33.2 | 28,142 | 9,363 | 6,846 | 2,278 |
| 100-105 | 41.0 | 7,327 | 3,006 | 4,018 | 1,648 |
| 105-110 | 50.0 | 1,042 | 521 | 1,098 | 549 |
| 110-115 | 60.3 | 361 | 218 | 378 | 228 |
| 115-120 | 72.0 | 77 | 55 | 75 | 54 |
| Totals: | | 36,949 | 13,163 | 12,415 | 4,757 |

# SECTION 5 LIST OF PREPARERS

This Special Environmental Assessment (SEA) has been prepared by the Department of the Air Force with contractual assistance from Spectrum Sciences and Software, Inc. (SPECTRUM). The following personnel contributed to the preparation of this assessment.

| Name/Affiliation | Education/Expertise | Contribution to EA |
|---|---|---|
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| LTC Cullen Hollister, P.E.<br>SAF/MIQ | M.S. Engineering<br>Twenty-four years engineering experience, nine year experience in environmental management | Purpose and Need and Alternatives |
| Harold E. Lindenhofen, Jr.<br>HQUSAF/CEVP | M.S. Chemistry<br>Twenty years experience in environmental science and environmental impact analysis | Noise Analysis |
| John Babicz<br>HQUSAF/CEVP | B.S. Civil Engineering.<br>Five years experience in environmental management | Purpose and Need and Alternatives |
| Robert C. Martin, Jr.<br>SPECTRUM | B.S. Chemical Engineering.<br>Twenty years experience in environmental engineering and environmental impact assessment | SPECTRUM Project Manager. Aircraft Operations and Noise Assessment. |

## List of Preparers - Continued

| Name/Affiliation | Education/Expertise | Contribution to EA |
|---|---|---|
| David L. Dennis<br>SPECTRUM | B.S. Systems Science. Eight years experience in aircraft noise modeling including development of USAF NOISEMAP and BASEOPS programs | NOISEMAP analysis. |
| Kenneth D. Shepardson<br>SPECTRUM | B.S. Systems Science. Five years of experience in computer systems applications, modeling and geographic information analysis. | Geographic information analysis and population estimates. |
| Michael Truffa<br>SPECTRUM | Two years experience in environmental impact analysis and noise modeling. | NOISEMAP analysis. |

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# APPENDIX A CEQ CORRESPONDENCE

EXECUTIVE OFFICE OF THE PRESIDENT
COUNCIL ON ENVIRONMENTAL QUALITY
WASHINGTON, D.C. 20503

March 19, 1991

Mr. Gary Vest
Deputy Assistant Secretary
Installations, Environment, and
Occupational Health
Department of the Air Force
The Pentagon, Room 4C916
Washington, D.C. 20330-1000

Dear Mr. Vest:

I am writing in response to your letter of March 15, 1991, concerning the ongoing Desert Storm airlift operations at Westover Air Force Base (AFB), Massachusetts.

I appreciate the efforts that the Department of the Air Force and other components of the Department of Defense (DOD) have made to identify changes which could be made to the flight schedules to alleviate noise impacts, and, after you were informed that this could not be done, to consider moving individuals affected by those noise impacts. I share your regret that neither of those options presently appear viable to you or to the United States Transportation Command.

I also understand your view that preparation of environmental analysis in connection with the on-going flights will not be of any value. However, one of the primary purposes of the National Environmental Policy Act (NEPA) is to inform the public about the environmental impacts of actions and to provide for an opportunity to participate in that analysis. It is possible that providing this information to the public will stimulate information or ideas of value. Further, as you know, the Council on Environmental Quality's (CEQ) regulation for emergency circumstances is not a waiver of all compliance with NEPA; rather, it provides for the establishment of alternative arrangements for procedural compliance with NEPA in emergency circumstances. 40 C.F.R. §1506.11. In these circumstances, CEQ asks that the following alternative arrangements be followed:

1. The Department of the Air Force shall immediately initiate preparation of an environmental assessment documenting the environmental impacts of operations which exceed the nature and number of flights preceding Desert Shield. The environmental assessment should analyze noise impacts, reasonable alternative landing sites on the East Coast, reasonable alternatives to current flights patterns, including reduction of nighttime departures, and other mitigation possibilities. All reasonable

efforts should be made to complete the environmental assessment within thirty days of the date of this letter. Please advise me if you believe completion of the environmental assessment will require more than thirty days.

2. The environmental assessment shall be provided to the CEQ, the Environmental Protection Agency (EPA), the Massachusetts Executive Office of Environmental Affairs, and interested and affected parties, including recipients of the 1987 EIS for beddown of the C-5As at Westover AFB. Additionally, a notice of availability shall be published in local newspapers of general circulation.

3. Thirty days of public comment shall be provided for the environmental assessment.

4. At the end of the comment period, the Department of the Air Force shall respond to all substantive comments received regarding the environmental assessment and provide copies of all comments and responses regarding the environmental assessment to CEQ and EPA. If flights are continuing at a level exceeding that identified in the 1987 EIS at the time comments and responses on the environmental assessment are concluded, the Department of the Air Force and other components of DOD shall again consult with CEQ concerning continuation of the emergency and environmental impacts.

5. Continued efforts shall be made by the Department of the Air Force and other components of DOD to remain alert to opportunities to lessen the nighttime use of Westover AFB.

We understand that due to the continuing emergency, operational missions will continue during compliance with these alternative arrangements. As you know, this is a major departure from normal compliance with NEPA and CEQ is sanctioning this only because of the exceptional circumstances in this case.

Sincerely,

Dinah Bear

Dinah Bear
General Counsel

# APPENDIX B NOISE ANALYSIS METHODOLOGY

## B.1 NOISE METRICS

### B.1.1 Single Event Metrics

#### B.1.1.1 Single-Event Instantaneous Sound Levels

The A-weighted sound level expressed in decibels (dB) is the measurement used to characterize single-event maximum sound levels. The A-scale de-emphasizes the low-and high-frequency portions of the sound spectrum and provides a good approximation of the response of the average human ear, correlating well with the average person's judgement of the relative loudness of a noise event. In contrast, C-weighted sound level is used for large amplitude impulse sounds such as sonic booms, explosions, and weapons noise.

On the decibel scale, an increase of 3 dB represents a doubling of sound energy. In reality, an increase of 3 dB is only moderately detectable by the human ear. It has been found that a difference on the order of 10 dB represents a subjective doubling of loudness. Thus, an increase of 3 dB corresponds to a doubling of sound energy, while an increase of 10 dB corresponds to a doubling in subjective loudness (USAF 1978). Table B.1 provides a comparison of the relative loudness of typical noises encountered in the indoor and outdoor environments.

#### B.1.1.2 Single-Event Energy Dose (Sound Exposure Level)

Subjective tests indicate that human response to noise is a function not only of the maximum level, but also of the duration of the event and its variation with respect to time. Significant evidence indicates that two noise events with equal sound energy will produce the same response. For example, a noise with a constant level of 85 dB lasting for 10 min would be judged to be equally as annoying as a noise event with a level of 82 dB and a duration of 20 min. (i.e., one-half the energy lasting for twice the time period). This is known as the "equal energy principle."

Table B.1 Sound levels (dB) and relative loudness of typical noise sources in outdoor and indoor environments

| dB(A) | Overall level | Community Noise Levels (Outdoor) | Home and Industry Noise Levels (Indoor) | Subjective Loudness (Relative to 70 dB) |
|---|---|---|---|---|
| 120 | Uncomfortably loud | Military jet aircraft take-off with afterburner from aircraft carrier at 50 ft (130) | Oxygen torch(121) | 32 times as loud |
| 110 | | Turbo-fan aircraft at takeoff power at 200 ft (118) | Riveting machine(110)<br>Rock band(108-114) | 16 times as loud |
| 100 | Very loud | Jet flyover at 1000 ft (103)<br>Boeing 707 DC-8 at 6080 ft before landing (106)<br>Bell J-2A helicopter at 100 ft (100) | | 8 times as loud |
| 90 | | Power mower (96)<br>Boeing 737 DC-9 at 6080 ft before landing (97)<br>Motorcycle at 25 ft (90) | Newspaper press (97) | 4 times as loud |
| 80 | | Car wash at 20 ft (89)<br>Prop plane flyover at 1000 ft (88)<br>Diesel truck 40 mph at 50 ft<br>Diesel train 45 mph at 100 ft (83) | Food blender (88)<br>Milling machine(85)<br>Garbage disposal (80) | 2 times as loud |
| 70 | Moderately loud | High urban ambient sound (80)<br>Passenger car 65 mph at 25 ft(77)<br>Freeway at 50 ft from pavement edge 10 a.m. (76-6) | Living room music(76)<br>TV-audio, vacuum cleaner (70) | 70 dB(A) |
| 60 | | Air conditioning unit at 100 ft (60) | Cash register at 10 ft (65-70)<br>Electric typewriter at 10 ft (64)<br>Dishwasher (Rinse) at 10 ft (60)<br>Conversation(60) | 1/2 as loud |
| 50 | Quiet | Large transformers at 100 ft (50) | | 1/4 as loud |
| 40 | | Bird calls (44)<br>Lowest limit of urban ambient sound (40) | | |
| | | dB Scale Interrupted | | |
| 10 | Just audible | | | |
| 0 | Threshold of Hearing | | | |

Source: M.C. Branch, et al., Outdoor Noise and the Metropolitan Environment, Department of City Planning, City of Los Angeles, 1970, p. 2.

The sound exposure level (SEL) is a measure of the physical energy of the noise event which takes into account both intensity (loudness) and duration. The SEL is based on the A-weighted sound level above a specified threshold which is at least 10 dB below the maximum value measured during the noise event and is expressed as the 1-sec energy averaged equivalent sound level (Leq-1 sec).

Table B.2 provides a comparison of the SEL values measured at a slant distance of 1000 ft from military and commercial aircraft operating at takeoff thrust. By definition, SEL values are normalized to a duration of 1 sec and should not be confused with either the average or maximum noise levels associated with a specific event. For example, an event with a duration of 20 sec and an SEL value of 111.5 dB (the value in Table B.2 for the C-5A aircraft) would have an energy averaged equivalent sound level of 98.5 dB. There is no general relationship between the SEL value and the maximum decibel level (ALm) measured during a noise event. By definition, noise levels which exceed the SEL value must have durations of <1 sec. For aircraft overflights, maximum noise levels would typically be 5 to 7 dB below the SEL value.

The SEL measure incorporates a single event, which is useful when making calculations involving aircraft flyovers. Frequency, magnitude, and duration vary according to aircraft type, engine type, and power setting. Therefore, individual aircraft noise data are collected for various types of aircraft/engines at different power settings and phases of flight. SEL versus slant range values are derived from noise measurements made according to a source noise data acquisition plan developed by Bolt, Beranek, and Newman, Inc., in conjunction with the Armstrong Aerospace Medical Research Laboratory (AAMRL) and carried out by AAMRL (Bishop and Galloway, 1975). These standard-day, sea-level values form the basis for the individual-event noise descriptors at any location and are adjusted to the location by applying appropriate corrections for temperature, humidity, altitude, and variations from standard aircraft operating profiles and power settings.

### B.1.2 Cumulative energy average metrics

Cumulative energy average metrics correlate well with aggregate community response to the noise environment. They may be derived from single event noise levels or computed from measured data. They were not designed as single source measures and they do not relate accurately to speech interference, sleep disturbance, or other phenomena requiring analysis using single event data (Newman and Beattie 1985).

**Table B.2** Sound Exposure Levels (SEL) for Air Force and Civil Aircraft

| Aircraft Type | Sound Exposure Level (SEL)[a] |
|---|---|
| **Jet Bomber/Tanker/Transport** | |
| B-52F, G | 120.5f |
| C-5 | 111.5 |
| C-135B | 106.5 |
| C-141 | 105.8 |
| KC-135A | 117.8 |
| KC-135R | 92.2 |
| **Other Jet Aircraft with Afterburners** | |
| F-4 | 116.5 |
| F-14 | 110.5 |
| F-15 | 112.0 |
| F-16 | 106.7 |
| FB-111 | 107.5 |
| T-38 | 105.5 |
| **Other Jet Aircraft without Afterburners** | |
| A-7 | 111.3 |
| A-10 | 96.9 |
| T-37 | 98.0 |
| T-39 | 103.0 |
| **Propeller Aircraft** | |
| C-12 | 79.3 |
| C-21 | 91.1 |
| C-130 | 90.0 |
| **Civil Jet Aircraft** | |
| 707, DC-8 | 110.0 |
| 727 | 108.0 |
| 737, DC-9 | 106.0 |
| 747 | 109.0 |
| DC-10, L-1011 | 100.0 |
| Learjet, Gulfstream II | 106.0 |

[a] At nominal takeoff thrust and airspeed and at a slant distance of 1,000 ft from the aircraft.

### B.1.2.1 Equivalent sound level

The equivalent sound level (Leq) is the energy averaged noise level (usually A-weighted) integrated over a specified time period. The term "equivalent" indicates that the total acoustical energy associated with a varying sound (measured during the specified period) is equal to the acoustical energy of a steady sound level of Leq for the same period of time. The purpose of the Leq is to provide a single number measure of noise averaged over a specified time period (Newman and Beattie 1985).

### B.1.2.2 Day-night average noise level

The Day-Night average noise level (DNL) is the energy averaged noise level (Leq) measured over a period of 24 hr, with a 10-dB penalty applied to nighttime (10 p.m. to 7 a.m.) sound levels to account for increased annoyance by noise during the night hours. The annual average DNL (DNL y-avg) is the value specified in the FAA FAR Part 150 noise compatibility planning process (Newman and Beattie 1985) and provides the basis for the land-use compatibility planning guidelines in the Air Force AICUZ program (AICUZ Handbook 1984). The typical range of DNL levels is illustrated in Fig. A.1.

## B.1.3 Basis for use of DNL as the single environmental descriptor

The DNL and Leq with a 10 dB penalty for nighttime exposure were selected as uniform descriptors of cumulative noise exposure to correlate with health and welfare effects. Subsequently, all Federal agencies adopted YDNL (Ldn) as the basis for describing community noise exposure. DNL methodology has consistently been shown in the national and international literature to work for large numbers of people under a wide range of noise conditions (including loud and soft noise levels, and frequent and infrequent numbers of discrete aircraft events). Although seasonal corrections are not included in the definition of the DNL metric, the methodology does not preclude its use in any analysis of a special, well-defined noise exposure scenario.

The DNL metric is not the perfect descriptor. Noise predictions are less reliable at lower levels of noise and at increasing distances from the airport, and the ability to determine the contribution of different noise sources becomes less. There are problems in interpreting results of predications since public health and welfare effects below Ldn 60 dB (Ldn 55 dB includes a 5 dB margin of safety) have not been established. Much of the criticism of the use of YDNL for community annoyance and land-use compatibility around airports stems from a lack of understanding of the basis for the measurement or calculation of that metric. An average noise metric, such as DNL, takes into account both the noise

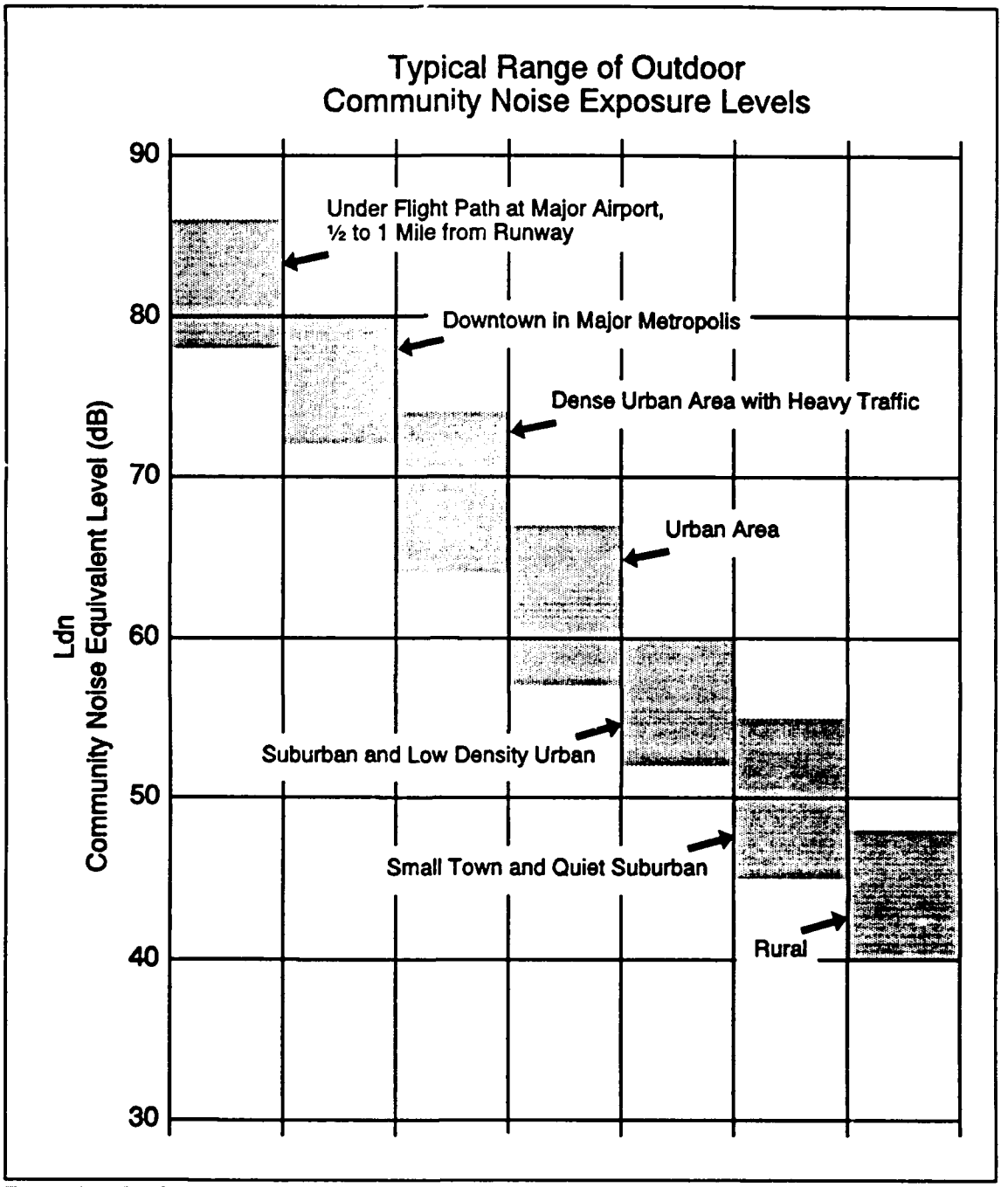


**Figure B.1** Typical Range of Outdoor Community Day-Night Average Noise Levels (DNL)

levels of all individual events that occur during a 24 hour period, and the number of times those events occur. The logarithmic nature of the dB unit causes noise levels of the loudest events to control the 24 hour average. The averaging of noise over a 24 hour period does not ignore the louder single events,

and it tends to emphasize both the sound level and number of those events. This is the basic concept of a time-averaged sound metric, and specifically DNL.

## B.2 NOISE ANALYSIS METHODOLOGY

### B.2.1 NOISEMAP Computer Program

The NOISEMAP program is actually a group of computer programs developed by the U.S. Air Force for prediction of noise exposures in the vicinity of an air base due to aircraft flight, maintenance, and ground run-up operations. These programs can also be used for noise exposure prediction at civilian or joint-use (military-civilian) airfields if appropriate noise reference files are available.

The NOISEMAP programs utilize a database of aircraft noise emission characteristics (NOISEFILE) which is accessed by the OMEGA10 and OMEGA11 subprograms to produce SEL versus slant range values specific to the aircraft operating parameters and meteorological conditions.

Data describing flight tracks, flight profiles, power settings, flight paths and profile utilization, and ground run-up information by type of aircraft/engine are assembled and processed for input into a central computer. The NOISEMAP program uses this information to calculate the $L_{dn}$ values at points on a regularly spaced 100x100 grid surrounding the airfield. This information is then input to another subprogram which generates contour lines which connect points of equal $L_{dn}$ in a manner similar to elevation contours shown on topographic maps. Contours are normally generated at 5 dB intervals beginning at a lower limit of 65 dB, the maximum level considered acceptable for unrestricted residential use.

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# APPENDIX C EFFECTS OF NOISE EXPOSURE

## C.1 EFFECTS OF NOISE EXPOSURE ON HUMANS

Environmental noise may interfere with a broad range of human activities degrading public health and welfare. Such activities include speech, sleep, learning, relaxation, listening, and other activities. The levels of environmental noise which interfere with human activity depend upon the activity and its contextual frame of reference. The effect of activity interference is often described in terms of annoyance. However, various other factors, such as attitude towards the noise source and local conditions, may influence an individual's reaction to activity interferences (U.S. Environmental Protection Agency, 1974).

### C.1.1 Annoyance

Annoyance is a summary measure of a general adverse reaction of people to noise which includes speech interference, sleep disturbance, desire for a tranquil environment and the ability to use the telephone, radio and television satisfactorily. A measure of this response is the percentage of area population that feels highly annoyed about noise of a specified level.

Noise is often defined as unpleasant or unwanted sound. Based on this definition, "noise" is a subjective evaluation by each individual. Annoyance has been described as a psychological response to a given noise exposure. It may result from speech or sleep interference, but it can arise in a variety of other circumstances. The perceived unpleasantness of the noise is a factor of annoyance, as is any anxiety or apprehension that the noise may cause (Franken, 1986). Community response is a term used to describe the annoyance of groups of people exposed to environmental noise sources in residential settings.

The preponderance of case histories and social surveys indicates that the response of a community to aircraft noise is affected not only by how loud the noise is, but also how often noise events

occur, e.g., the total noise exposure in a specified time period. This is consistent with the laboratory results of psychoacoustic experiments that show that magnitude of sound and its duration are exchanges on an energy summation basis. On the assumption that community response is related to the total noise energy in a specified time period, events of equal magnitude are summed on the basis of 10 Log N where N is the number of events. Recent studies have shown that 10 Log N can be used to accurately predict community annoyance for daily operations of noise events as low as 2 per day (Schomer, 1981; and Fields and Powell, 1985) while other studies had previously shown that 10 Log N worked well for cumulative noise exposure for several hundred events per day.

In general, the effects of noise on people results from complex relationships of numerous factors, and separating the effects of these often confounding factors is impractical if not impossible. The variability in the way individuals react to noise makes it impossible to accurately predict how any one individual will respond to a given noise. However, when the community is considered as a whole, trends emerge which relate noise to annoyance. DNL alone provides an adequate indicator of community annoyance to aircraft noise. EPA's Levels document states "This formula of equivalent level [DNL] is used here to relate noise in residential environments to chronic annoyance by speech interference and in some part by sleep and activity interference."

In 1978, Schultz synthesized a relationship between transportation noise exposure and the prevalence of annoyance in communities from the findings of a number of social surveys. These assessments have become the model for assessing the effects of long-term noise exposure on communities. Schultz developed methods for converting noise exposures measured in different units to a common set of units - DNL - and devised ways of comparing annoyance judgements measured on very different response scales. The independent variable Schultz chose for the dosage-effect relationship was a cumulative measure of the time integral of noise intensity to which the communities are exposed. The dependent variable was a measure of the upper portion of the distribution of self-reported annoyance. The resulting metric, "Percent Highly Annoyed" is symbolically illustrated as (%HA). The logistic fits by Harris to Schultz (161 points) and an update of 400 data points are expressed by the following relationship:

Fit to 400 points: $\%HA = 100/[1 + EXP(11.13 - .141\ LDN)]$

Schultz Fit: $\%HA = 100/[1 + EXP(10.43 - .132\ LDN)]$

This approximation was adopted in preference to a third order polynomial least squares fit as recommended by Fidell et al, 1989 to ensure the dosage-effect relationship predicts no annoyance at an exposure level of $L_{dn}$ 45 dB and conforms with the EPA Levels document. Results derived from a recent analysis of the update of 400 data points to the Schultz curve validate the continued accuracy of the Schultz relationship between $L_{dn}$ and %HA. Further, %HA remains the best approach since the updated curve differs less than one percent in the DNL range of 45 dB to 75 dB from the original logistics fit. Finally, the review also concluded that the DNL-%HA relationship is valid for all types of transportation noise. The new curve is shown in Figure D.1.

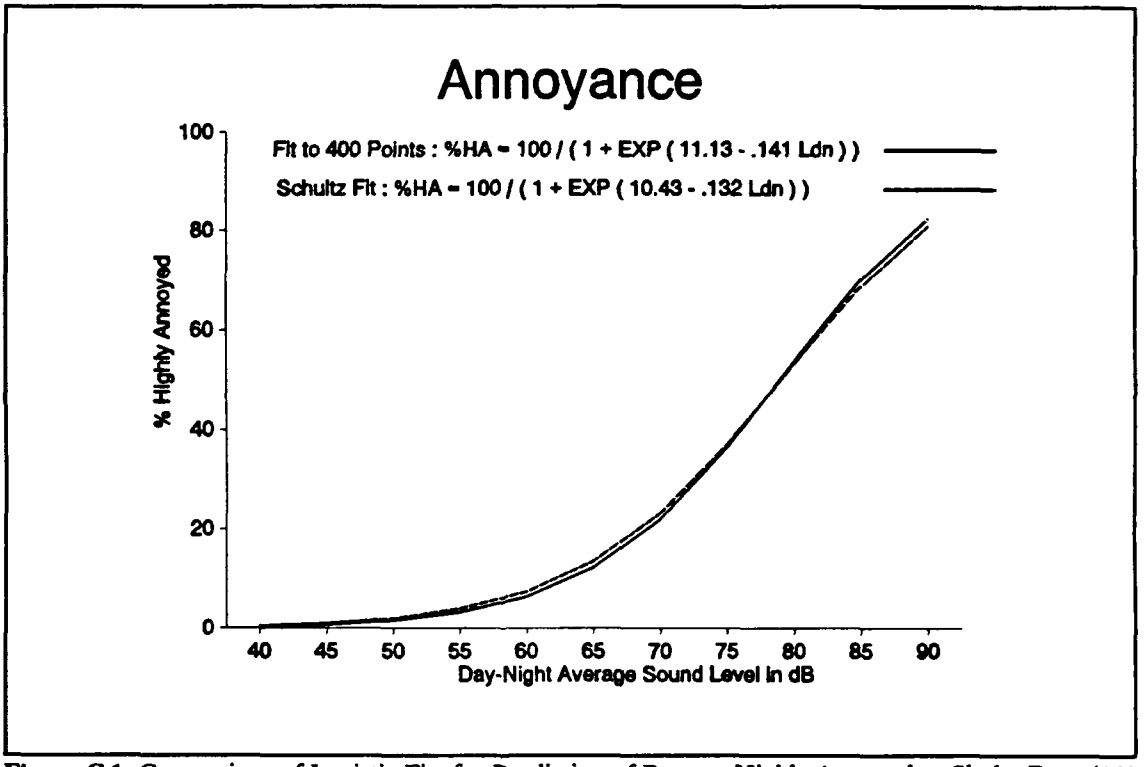


**Figure C.1** Comparison of Logistic Fits for Prediction of Percent Highly Annoyed to Shultz Data (161 points) and Update of 400 Data Points

Thus, the "Schultz curve" is the best available source of empirical dosage-effect information to predict community response to transportation noise. Annoyance is the characterization of the community response. On the other hand, complaints are not a measure of community impact. The analysis of complaints by Luz, Raspet and Schomer (1985) supports noise abatement (reduction) policies based on an assessment of the level of annoyance rather than the number of complaints. Annoyance can exist without complaints and conversely, complaints may exist without adverse noise levels. The

current body of evidence indicates that complaints are an inadequate indicator of the full extent of noise effects on a population (Fields and Hall, 1987).

The estimates of annoyance presented in this document are based on the average percentages highly annoyed for each DNL interval as indicated in Table C.3.

**Table C.1** Average Percent Highly Annoyed by DNL Interval

| DNL Interval (dB) | Average Percent of Exposed Population Highly Annoyed |
|---|---|
| 65-70 | 21 |
| 70-75 | 32 |
| 75-80 | 46 |
| >80 | 63 |

### C.1.2 Speech Interference

Speech interference associated with aircraft noise is a primary source of annoyance to individuals on the ground. The disruption of leisure activities (such as listening to the radio, television, music, and conversation) gives rise to frustration and irritation. Quality speech communication is obviously also important in the classroom, office, and industrial settings. Researchers have found that aircraft noise of 75 dB annoyed the highest percentage of the population when it interfered with the television sound. Eighty percent of the test population reported being annoyed. Also high on the list of annoyances for the surveyed population was flickering of the television picture and interference with casual conversation by aircraft noise (Newman and Beattie 1985).

The levels which interfere with listening to a desired sound such as speech or music can be defined in terms of the level of interfering sound required to mask the desired sound. Such levels have been quantified for speech communication by directly measuring the interference with speech intelligibility as a function of the level of the intruding sound relative to the level of speech sounds (U.S. Environmental Protection Agency 1974). In general, it was found that intelligibility is related to the amount by which the levels of speech signals exceed steady state noise levels. The difference between

speech and noise levels is usually referred to as the speech-to-noise ratio. Finally, since no quantitative relationship has been established between speech interference and learning, no additional criteria have been developed for determining speech interference effects on learning.

### C.1.3 Sleep Interference

The effects of noise on sleep have long been a concern of parties interested in assuring residential noise environments. Early studies, conducted mainly in the 1970's, noted background levels in people's bedrooms in which sleep was apparently undisturbed by noise. Various A-weighted levels between 25 and 50 dB were observed to be associated with an absence of sleep disturbance. Tests were conducted mainly in laboratory environments in which awakening was measured either by a verbal response or by a button push, or by EEG brain wave recordings indicating stages of sleep (and awakening). Various types of noise were presented to the sleeping subjects throughout the night. These noises consisted primarily of transportation noises, including those produced by aircraft, trucks, cars and trains. The aircraft noises included both subsonic aircraft flyover noises as well as sonic booms. Synthetic noises, including laboratory-generated sounds consisting of shaped noises and tones, were also studied (U.S. Department of Defense, USAF/AAMRL, 1991a).

Literature reviews of the EPA Levels and related documents reveals no known health effects are associated with either waking or sleep-stage changes; neither measure is potentially useful as a metric of sleep disturbance. Additionally, no definitive relationship between the sleep disturbance and the quality of sleep has been established. However, since waking, unlike sleep-stage changes, is simple to quantify, it was selected as the preferred metric for estimating the effects of noise on sleep.

Reviews by Griefahn and Muzent (1978) and Lukas (1975) provided reviews of data available in the 1970's on sleep-stage changes and waking effects of different levels of noise. Since the variability of the data used in these two reviews is actually greater than the absolute differences in the effects observed, the Lukas prediction equation is deemed to be useful only for predicting absolute worst-case sleep disturbance. Thus, careful use of this data should be considered when applied to the environmental impact analysis.

After reviewing the most recent scientific data, DNL is still considered the appropriate metric for assessing the noise impact of the vast majority of nighttime aircraft operations. The 10-dB night-time penalty levied against noise during the 10 PM to 7 AM period is designed to specifically account for the intrusiveness of noise during this period and its potential impact on sleep. However, some

agencies recognize that an unusual number of night-time noise events may warrant supplemental information, such as sleep disruption predictions in an environmental analysis. This supplemental information is frequently single event analysis. For the purpose of providing supplemental information when warranted, the Air Force has developed an interim dose-response model to predict % Awakened as a function of single event noise levels. This interim model is based on statistical adjustment of the most recent, inclusive analysis of published sleep disturbance studies conducted by Pearson et.al. (1989). The equation is:

$$\% \text{ Awakened} = 7.079 \times 10^{-6} * SEL^{3.496}$$

As reported in the 1989 study, the effort to develop an awakening prediction model identified the need for substantially more research in this area. Of concern were:

- large discrepancies between laboratory and field studies;
- highly variable and incomplete data bases;
- lack of appropriate field studies;
- how the studies were conducted;
- the need to consider non-acoustic effects;
- the role of habituation.

A graphic depiction of the interim dose-response curve is shown in Figure D.2. This relationships may used to estimate the average percentage of the exposed population within various SEL intervals who would be expected to be awakened by a single aircraft noise event. The average percentages used in this analysis are summarized in Table C.4.

In comparing predictions of the number of persons awakened by a single noise event, it must be noted that the SEL values used in noise modeling represent the average or numerous values collected under carefully controlled conditions and standardized to reference meteorological conditions. Even under carefully controlled conditions, SEL values for individual events show a significant variation. In actual airport operations, variations in aircraft weight, power settings, and flap configuration as well as specific meteorological conditions at the time of the event may result in even greater variations in SEL values for individual events. The SEL values for each type of operation by a single type of aircraft may exhibit a typical range of more than 20 dB, with a standard deviation of at least six to seven dB (Galloway 1991). Thus, the predicted values for single events are useful primarily for comparison of the long-term average effects and should not be considered as values for any single operation.

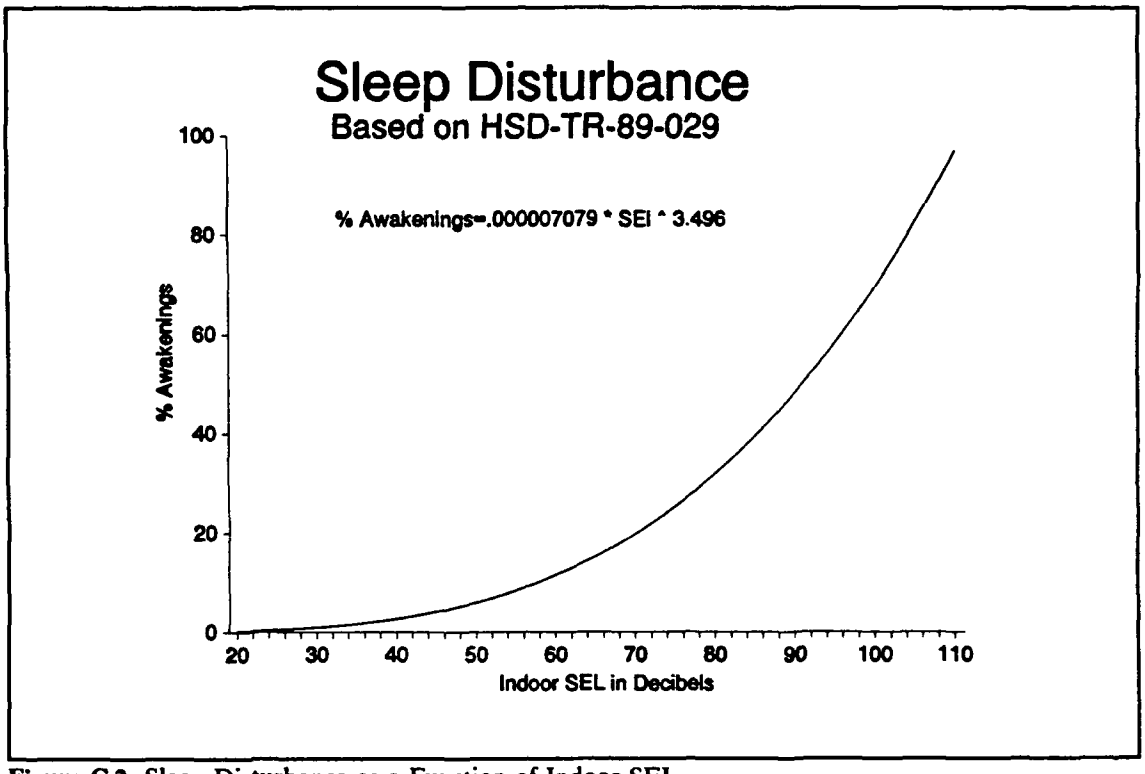


**Figure C.2** Sleep Disturbance as a Function of Indoor SEL

**Table C.2** Average Percent Awakened as a Function of Indoor SEL Values

| Response | | Outdoor SEL Interval | Average % Awakened | | |
|---|---|---|---|---|---|
| SEL | Percent Awakened | | 0 dB Attenuation (Outdoors) | 17 dB Attenuation (Windows Open) | 27 dB Attenuation (Windows Closed) |
| 45 | 4.26 | | | | |
| 50 | 6.16 | 45-50 | 5.34 | 1.16 | 0.30 |
| 55 | 8.60 | 50-55 | 7.55 | 1.95 | 0.63 |
| 60 | 11.65 | 55-60 | 10.35 | 3.08 | 1.16 |
| 65 | 15.41 | 60-65 | 13.82 | 4.60 | 1.95 |
| 70 | 19.97 | 65-70 | 18.05 | 6.60 | 3.08 |
| 75 | 25.42 | 70-75 | 23.13 | 9.15 | 4.60 |
| 80 | 31.85 | 75-80 | 29.16 | 12.34 | 6.60 |
| 85 | 39.37 | 80-85 | 36.23 | 16.26 | 9.15 |
| 90 | 48.08 | 85-90 | 44.45 | 20.99 | 12.34 |
| 95 | 58.09 | 90-95 | 53.92 | 26.63 | 16.26 |
| 100 | 69.50 | 95-100 | 64.76 | 33.27 | 20.99 |
| 105 | 82.42 | 100-105 | 77.06 | 41.02 | 26.63 |
| 110 | 96.98 | 105-110 | 90.95 | 49.98 | 33.27 |
| 115 | 113.28 | >110 | 100.00 | 60.25 | 41.02 |

### C.1.4 Hearing Loss

Hearing loss can be either temporary or permanent. A noise-induced temporary threshold shift is a temporary loss of hearing experienced after a relatively short exposure to excessive noise. A noise-induced threshold shift means that the detection level of sound has been increased. Recovery is fairly rapid after cessation of the noise. A noise-induced permanent threshold shift is an irreversible loss of hearing caused by prolonged exposure to excessive noise. This loss is essentially indistinguishable from the normal hearing loss associated with aging. Permanent hearing loss is generally associated with destruction of the hair cells of the inner ear. Based on EPA criteria, hearing loss is not expected for people living within noise contours below DNL levels of 75 dB. Further, as stated in the EPA "Levels Document," changes in hearing levels of 5 dB are generally not considered noticeable or significant (EPA 1974).

An outdoor DNL of 75 dB is considered as the threshold above which the risk of hearing loss is evaluated. Following the guidelines recommended by the Committee on Hearing, Bioacoustics, and

Biomechanics (NAS 1977), the average change in threshold of hearing for areas exposed to DNL noise levels of 75 dB and above has been evaluated. Results show that an average of 1-dB hearing loss could be expected for people exposed to DNL 75 dB and above. For the most sensitive 10% of the exposed population, the maximum anticipated hearing loss would be 4 dB. These hearing-loss projections must be considered worst-case predictions because the calculations are based on an average daily outdoor exposure of 16 hr (7:00 a.m. to 10:00 p.m.) over a 40-year period. It is doubtful that any individual will spend this amount of time outdoors within the DNL 75 dB and above noise contours. Changes in hearing levels of less than 5 dB are generally not considered by EPA to be noticeable or significant (EPA 1974). Therefore, based on a worst-case scenario, no appreciable hearing losses are expected to result from implementation of either the proposed or alternate mission change.

### C.1.5 Nonauditory Health Effects

Predictions of nonauditory health effects of residential aircraft noise cannot be made on the basis of available scientific information. A valid predictive procedure requires: (1) evidence for a causal relationship between aircraft noise exposure and adverse nonauditory health consequences, and (2) knowledge of a quantitative relationship between amounts of noise exposure (dose) and specific health effects (i.e., a dose-response curve). Because results of studies of aircraft noise on health are highly equivocal, there currently is no sound scientific basis for making adequate risk assessments.

Potential nonauditory health consequences of aircraft noise exposure which have been studied include birth defects, low birth weight, mental problems, cancer, stroke, hypertension, sudden cardiac death, myocardial infarction, and cardiac arrhythmias. Of these, hypertension is the most biologically plausible effect of noise exposure. Noise appears to elicit many of the same biochemical and physiological reactions, including temporary elevation of blood pressure, as do many other environmental stressors. The notion that repeated elevations of blood pressure may lead to sustained hypertension has been reported from short term laboratory and animal experiments (Peterson et al., 1984).

Studies in areas exposed to residential aircraft noise have produced contradictory results which are difficult to interpret. Some studies show morbidity due to hypertension higher around airports than areas located away from airports, while others in areas of sonic boom exposure show no evidence of relationship between noise exposure and morbidity. Some European research has shown a positive association between exposure to aircraft noise and adverse health effects including a recent study which showed more pronounced effects on females than on males.

The critical question is whether observed positive associations are causal ones. Cross-sectional studies cannot establish the time precedence of noise exposure, since the noise exposure was measured at the same time as the health effect. Three studies which have documented exposure to precede effects have failed to show a statistically significant association between aircraft noise exposure and elevated blood pressure. These and other related studies, however, cannot be considered definitive because of insufficient sample sizes and other methodological problems.

## C.2 EFFECTS ON DOMESTIC ANIMALS AND WILDLIFE

It has been know for many years that certain noises may cause physiological responses in some domestic animals. The primary domestic animals in Hampden and Hampshire counties are poultry, swine, and cattle. Each of these species has been the subject of noise studies.

EPA has reviewed the literature on noise effects in domestic animals (Dufour 1980). In general, there is an overall trend for domestic animals to adapt to intermittent (aircraft or aircraft-like) noise under 120 dB. Busnel (1978) reviewed effects around large airports and found no evidence to indicate noise-related adverse effects.

Possible adverse effects of noise exposure on wildlife include stress, hearing loss, interference with communication, physiological changes, behavioral reactions or changes, reduced reproductive success, and reduction of populations within the areas affected by the noise. The impact of noise exposure will generally be greater if the noise events are unexpected, if the noise events occur suddenly, if noise levels are high, and if the individual animal is inexperienced with noise. The impacts may also vary with the source of the noise and with the duration and frequency pattern of the noise (Fletcher 1978; Shotton 1982; EPA 1980).

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# APPENDIX D AIRCRAFT OPERATIONS DATA AND SUPPLEMENTAL NOISE ANALYSIS

## D.1 AIRCRAFT OPERATIONS DATA

Table D.1 summarizes the aircraft operations data used in preparation of the 1990 Air Installation Compatible Use Zone (AICUZ) Study for Westover AFB and considered representative of operations prior to initiation of Operation DESERT SHIELD. The operations data for transient military and civil aviation aircraft was used in this analysis as representative of operations not related to support of forces in the gulf. Tables D.2 and D.3 summarize the current (January to March 1991) and projected aircraft operations, respectively.

# Table D.1 Aircraft Operations at Westover AFB prior to Operation DESERT SHIELD

| Aircraft | Arrivals | | | Departures | | | Closed | | | Takeoffs | | | Landings | | | Total Operations | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Day | Night | Total | Day | Night | Total | Day | Night | Total | Day | Night | Total | Day | Night | Total | Day | Night | Total |
| **Based Aircraft** | | | | | | | | | | | | | | | | | | |
| C-5A | 2.94 | 0.16 | 3.10 | 2.94 | 0.16 | 3.10 | 30.95 | 0.00 | 30.95 | 33.89 | 0.16 | 34.05 | 33.89 | 0.16 | 34.05 | 67.78 | .32 | 68.10 |
| UH-1N | 1.41 | 0.09 | 1.50 | 1.41 | 0.09 | 1.50 | 20.61 | 0.00 | 20.61 | 22.02 | 0.09 | 22.11 | 22.02 | 0.09 | 22.11 | 44.04 | 0.18 | 44.22 |
| Subtotal: | 4.35 | 0.25 | 4.60 | 4.35 | 0.25 | 4.60 | 51.56 | 0.00 | 51.56 | 55.91 | 0.25 | 56.16 | 55.91 | 0.25 | 56.16 | 111.82 | 0.50 | 112.32 |
| **Transient Military** | | | | | | | | | | | | | | | | | | |
| A-10A | 0.80 | 0.00 | 0.80 | 0.80 | 0.00 | 0.80 | 2.64 | 0.00 | 2.64 | 3.44 | 0.00 | 3.44 | 3.44 | 0.00 | 3.44 | 6.88 | 0.00 | 6.88 |
| B-52G | 0.02 | 0.00 | 0.02 | 0.02 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.02 | 0.02 | 0.00 | 0.02 | 0.04 | 0.00 | 0.04 |
| C-7 | 0.33 | 0.00 | 0.33 | 0.33 | 0.00 | 0.33 | 0.22 | 0.00 | 0.22 | 0.55 | 0.00 | 0.55 | 0.55 | 0.00 | 0.55 | 1.10 | 0.00 | 1.10 |
| C-12 | 0.21 | 0.00 | 0.21 | 0.21 | 0.00 | 0.21 | 0.09 | 0.00 | 0.09 | 0.30 | 0.00 | 0.30 | 0.30 | 0.00 | 0.30 | 0.60 | 0.00 | 0.60 |
| C-130 | 1.57 | 0.00 | 1.57 | 1.57 | 0.00 | 1.57 | 9.44 | 0.00 | 9.44 | 11.01 | 0.00 | 11.01 | 11.01 | 0.00 | 11.01 | 22.02 | 0.00 | 22.02 |
| F-15 | 0.09 | 0.00 | 0.09 | 0.09 | 0.00 | 0.09 | 0.09 | 0.00 | 0.09 | 0.18 | 0.00 | 0.18 | 0.18 | 0.00 | 0.18 | 0.36 | 0.00 | 0.36 |
| P-3 | 0.11 | 0.00 | 0.11 | 0.11 | 0.00 | 0.11 | 3.33 | 0.00 | 3.33 | 3.44 | 0.00 | 3.44 | 3.44 | 0.00 | 3.44 | 6.88 | 0.00 | 6.88 |
| T-37 | 0.17 | 0.00 | 0.17 | 0.17 | 0.00 | 0.17 | 0.69 | 0.00 | 0.69 | 0.86 | 0.00 | 0.86 | 0.86 | 0.00 | 0.86 | 1.72 | 0.00 | 1.72 |
| T-38 | 0.05 | 0.00 | 0.05 | 0.05 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.05 | 0.05 | 0.00 | 0.05 | 0.10 | 0.00 | 0.10 |
| UH-1N | 0.24 | 0.00 | 0.24 | 0.24 | 0.00 | 0.24 | 0.00 | 0.00 | 0.00 | 0.24 | 0.00 | 0.24 | 0.24 | 0.00 | 0.24 | 0.48 | 0.00 | 0.48 |
| Subtotal: | 3.59 | 0.00 | 3.59 | 3.59 | 0.00 | 3.59 | 16.50 | 0.00 | 16.50 | 20.09 | 0.00 | 20.09 | 20.09 | 0.00 | 20.09 | 40.18 | 0.00 | 40.18 |
| **Civil Aircraft** | | | | | | | | | | | | | | | | | | |
| DC-9 | 3.10 | 0.00 | 3.10 | 3.10 | 0.00 | 3.10 | 0.00 | 0.00 | 0.00 | 3.10 | 0.00 | 3.10 | 3.10 | 0.00 | 3.10 | 6.20 | 0.00 | 6.20 |
| MU-3A | 0.31 | 0.00 | 0.31 | 0.31 | 0.00 | 0.31 | 0.00 | 0.00 | 0.00 | 0.31 | 0.00 | 0.31 | 0.31 | 0.00 | 0.31 | 0.62 | 0.00 | 0.62 |
| Beech | 0.48 | 0.00 | 0.48 | 0.48 | 0.00 | 0.48 | 0.00 | 0.00 | 0.00 | 0.48 | 0.00 | 0.48 | 0.48 | 0.00 | 0.48 | 0.96 | 0.00 | 0.96 |
| Subtotal: | 3.89 | 0.00 | 3.89 | 3.89 | 0.00 | 3.89 | 0.00 | 0.00 | 0.00 | 3.89 | 0.00 | 3.89 | 3.89 | 0.00 | 3.89 | 7.78 | 0.00 | 7.78 |
| **Totals** | 11.83 | 0.25 | 12.08 | 11.83 | 0.25 | 12.08 | 68.06 | 0.00 | 68.06 | 79.89 | 0.25 | 80.14 | 79.89 | 0.25 | 80.14 | 159.78 | 0.50 | 160.28 |

# Table D.2 Current Aircraft Operations at Westover AFB (January - March, 1991)

| Aircraft | Arrivals | | | Departures | | | Closed | | | Takeoffs | | | Landings | | | Total Operations | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Day | Night | Total | Day | Night | Total | Day | Night | Total | Day | Night | Total | Day | Night | Total | Day | Night | Total |
| **Based Aircraft** | | | | | | | | | | | | | | | | | | |
| C-5A | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| UH-1N | 1.41 | 0.09 | 1.50 | 1.41 | 0.09 | 1.50 | 20.61 | 0.00 | 20.61 | 22.02 | 0.09 | 22.11 | 22.02 | 0.09 | 22.11 | 44.04 | 0.18 | 44.22 |
| Subtotal: | 1.41 | 0.09 | 1.50 | 1.41 | 0.00 | 1.50 | 20.61 | 0.00 | 20.61 | 22.02 | 0.09 | 22.11 | 22.02 | 0.09 | 22.11 | 44.04 | 0.18 | 44.22 |
| **Support Operations** | | | | | | | | | | | | | | | | | | |
| C-5 | 6.50 | 3.50 | 10.00 | 6.50 | 3.5 | 10.00 | 0.00 | 0.00 | 0.00 | 6.50 | 3.50 | 10.00 | 6.50 | 3.50 | 10.00 | 13.00 | 7.00 | 20.00 |
| C-130 | 1.54 | 0.48 | 2.02 | 1.54 | 0.48 | 2.02 | 0.00 | 0.00 | 0.00 | 1.54 | 0.48 | 2.02 | 1.54 | 0.48 | 2.02 | 3.08 | 0.96 | 4.04 |
| C-141 | 0.18 | 0.07 | 0.25 | 0.18 | 0.07 | 0.25 | 0.00 | 0.00 | 0.00 | 0.18 | 0.07 | 0.25 | 0.18 | 0.07 | 0.25 | 0.36 | 0.14 | 0.50 |
| Subtotal: | 8.22 | 4.05 | 12.27 | 8.22 | 4.05 | 12.27 | 0.00 | 0.00 | 0.00 | 8.22 | 4.05 | 12.27 | 8.22 | 4.05 | 12.27 | 16.44 | 8.10 | 24.54 |
| **Transient Military** | | | | | | | | | | | | | | | | | | |
| A-10A | 0.80 | 0.00 | 0.80 | 0.80 | 0.00 | 0.80 | 2.64 | 0.00 | 2.64 | 3.44 | 0.00 | 3.44 | 3.44 | 0.00 | 3.44 | 6.88 | 0.00 | 6.88 |
| B-52G | 0.02 | 0.00 | 0.02 | 0.02 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.02 | 0.02 | 0.00 | 0.02 | 0.04 | 0.00 | 0.04 |
| C-7 | 0.33 | 0.00 | 0.33 | 0.33 | 0.00 | 0.33 | 0.22 | 0.00 | 0.22 | 0.55 | 0.00 | 0.55 | 0.55 | 0.00 | 0.55 | 1.10 | 0.00 | 1.10 |
| C-12 | 0.21 | 0.00 | 0.21 | 0.21 | 0.00 | 0.21 | 0.09 | 0.00 | 0.09 | 0.30 | 0.00 | 0.30 | 0.30 | 0.00 | 0.30 | 0.60 | 0.00 | 0.60 |
| C-130 | 1.57 | 0.00 | 1.57 | 1.57 | 0.00 | 1.57 | 9.44 | 0.00 | 9.44 | 11.01 | 0.00 | 11.01 | 11.01 | 0.00 | 11.01 | 22.02 | 0.00 | 22.02 |
| F-15 | 0.09 | 0.00 | 0.09 | 0.09 | 0.00 | 0.09 | 0.09 | 0.00 | 0.09 | 0.18 | 0.00 | 0.18 | 0.18 | 0.00 | 0.18 | 0.36 | 0.00 | 0.36 |
| P-3 | 0.11 | 0.00 | 0.11 | 0.11 | 0.00 | 0.11 | 3.33 | 0.00 | 3.33 | 3.44 | 0.00 | 3.44 | 3.44 | 0.00 | 3.44 | 6.88 | 0.00 | 6.88 |
| T-37 | 0.17 | 0.00 | 0.17 | 0.17 | 0.00 | 0.17 | 0.69 | 0.00 | 0.69 | 0.86 | 0.00 | 0.86 | 0.86 | 0.00 | 0.86 | 1.72 | 0.00 | 1.72 |
| T-38 | 0.05 | 0.00 | 0.05 | 0.05 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.05 | 0.05 | 0.00 | 0.05 | 0.10 | 0.00 | 0.10 |
| UH-1N | 0.24 | 0.00 | 0.24 | 0.24 | 0.00 | 0.24 | 0.00 | 0.00 | 0.00 | 0.24 | 0.00 | 0.24 | 0.24 | 0.00 | 0.24 | 0.48 | 0.00 | 0.48 |
| Subtotal: | 3.59 | 0.00 | 3.59 | 3.59 | 0.00 | 3.59 | 16.50 | 0.00 | 16.50 | 20.09 | 0.00 | 20.09 | 20.09 | 0.00 | 20.09 | 40.18 | 0.00 | 40.18 |
| **Civil Aircraft** | | | | | | | | | | | | | | | | | | |
| DC-9 | 3.10 | 0.00 | 3.10 | 3.10 | 0.00 | 3.10 | 0.00 | 0.00 | 0.00 | 3.10 | 0.00 | 3.10 | 3.10 | 0.00 | 3.10 | 6.20 | 0.00 | 6.20 |
| MU-3A | 0.31 | 0.00 | 0.31 | 0.31 | 0.00 | 0.31 | 0.00 | 0.00 | 0.00 | 0.31 | 0.00 | 0.31 | 0.31 | 0.00 | 0.31 | 0.62 | 0.00 | 0.62 |
| Beech | 0.48 | 0.00 | 0.48 | 0.48 | 0.00 | 0.48 | 0.00 | 0.00 | 0.00 | 0.48 | 0.00 | 0.48 | 0.48 | 0.00 | 0.48 | 0.96 | 0.00 | 0.96 |
| Subtotal | 3.89 | 0.00 | 3.89 | 3.89 | 0.00 | 3.89 | 0.00 | 0.00 | 0.00 | 3.89 | 0.00 | 3.89 | 3.89 | 0.00 | 3.89 | 7.78 | 0.00 | 7.78 |
| **Totals** | 17.11 | 4.14 | 21.25 | 17.11 | 4.14 | 21.25 | 37.11 | 0.00 | 37.11 | 54.22 | 4.14 | 58.36 | 54.22 | 4.14 | 58.36 | 108.44 | 8.28 | 116.72 |

# Table D.3 Projected Aircraft Operations at Westover AFB

| Aircraft | Arrivals | | | Departures | | | Closed | | | Takeoffs | | | Landings | | | Total Operations | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Day | Night | Total | Day | Night | Total | Day | Night | Total | Day | Night | Total | Day | Night | Total | Day | Night | Total |
| **Based Aircraft** | | | | | | | | | | | | | | | | | | |
| C-5A | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| UH-1N | 1.41 | 0.09 | 1.50 | 1.41 | 0.09 | 1.50 | 20.61 | 0.00 | 20.61 | 22.02 | 0.09 | 22.11 | 22.02 | 0.09 | 22.11 | 44.04 | 0.18 | 44.22 |
| Subtotal: | 1.41 | 0.09 | 1.50 | 1.41 | 0.00 | 1.50 | 20.61 | 0.00 | 20.61 | 22.02 | 0.09 | 22.11 | 22.02 | 0.09 | 22.11 | 44.04 | 0.18 | 44.22 |
| **Support Operations** | | | | | | | | | | | | | | | | | | |
| C-5 | 13.00 | 7.00 | 20.00 | 13.00 | 7.00 | 20.00 | 0.00 | 0.00 | 0.00 | 13.00 | 7.00 | 20.00 | 13.00 | 7.00 | 20.00 | 26.00 | 14.00 | 40.00 |
| C-130 | 1.54 | 0.48 | 2.02 | 1.54 | 0.48 | 2.02 | 0.00 | 0.00 | 0.00 | 1.54 | 0.48 | 2.02 | 1.54 | 0.48 | 2.02 | 3.08 | 0.96 | 4.04 |
| C-141 | 0.18 | 0.07 | 0.25 | 0.18 | 0.07 | 0.25 | 0.00 | 0.00 | 0.00 | 0.18 | 0.07 | 0.25 | 0.18 | 0.07 | 0.25 | 0.36 | 0.14 | 0.50 |
| Subtotal: | 14.72 | 7.55 | 22.27 | 14.72 | 7.55 | 22.27 | 0.00 | 0.00 | 0.00 | 14.72 | 7.55 | 22.27 | 14.72 | 7.55 | 22.27 | 29.44 | 15.10 | 44.54 |
| **Transient Military** | | | | | | | | | | | | | | | | | | |
| A-10A | 0.80 | 0.00 | 0.80 | 0.80 | 0.00 | 0.80 | 2.64 | 0.00 | 2.64 | 3.44 | 0.00 | 3.44 | 3.44 | 0.00 | 3.44 | 6.88 | 0.00 | 6.88 |
| B-52G | 0.02 | 0.00 | 0.02 | 0.02 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.02 | 0.02 | 0.00 | 0.02 | 0.04 | 0.00 | 0.04 |
| C-7 | 0.33 | 0.00 | 0.33 | 0.33 | 0.00 | 0.33 | 0.22 | 0.00 | 0.22 | 0.55 | 0.00 | 0.55 | 0.55 | 0.00 | 0.55 | 1.10 | 0.00 | 1.10 |
| C-12 | 0.21 | 0.00 | 0.21 | 0.21 | 0.00 | 0.21 | 0.09 | 0.00 | 0.09 | 0.30 | 0.00 | 0.30 | 0.30 | 0.00 | 0.30 | 0.60 | 0.00 | 0.60 |
| C-130 | 1.57 | 0.00 | 1.57 | 1.57 | 0.00 | 1.57 | 9.44 | 0.00 | 9.44 | 11.01 | 0.00 | 11.01 | 11.01 | 0.00 | 11.01 | 22.02 | 0.00 | 22.02 |
| F-15 | 0.09 | 0.00 | 0.09 | 0.09 | 0.00 | 0.09 | 0.09 | 0.00 | 0.09 | 0.18 | 0.00 | 0.18 | 0.18 | 0.00 | 0.18 | 0.36 | 0.00 | 0.36 |
| P-3 | 0.11 | 0.00 | 0.11 | 0.11 | 0.00 | 0.11 | 3.33 | 0.00 | 3.33 | 3.44 | 0.00 | 3.44 | 3.44 | 0.00 | 3.44 | 6.88 | 0.00 | 6.88 |
| T-37 | 0.17 | 0.00 | 0.17 | 0.17 | 0.00 | 0.17 | 0.69 | 0.00 | 0.69 | 0.86 | 0.00 | 0.86 | 0.86 | 0.00 | 0.86 | 1.72 | 0.00 | 1.72 |
| T-38 | 0.05 | 0.00 | 0.05 | 0.05 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.05 | 0.05 | 0.00 | 0.05 | 0.10 | 0.00 | 0.10 |
| UH-1N | 0.24 | 0.00 | 0.24 | 0.24 | 0.00 | 0.24 | 0.00 | 0.00 | 0.00 | 0.24 | 0.00 | 0.24 | 0.24 | 0.00 | 0.24 | 0.48 | 0.00 | 0.48 |
| Subtotal: | 3.59 | 0.00 | 3.59 | 3.59 | 0.00 | 3.59 | 16.50 | 0.00 | 16.50 | 20.09 | 0.00 | 20.09 | 20.09 | 0.00 | 20.09 | 40.18 | 0.00 | 40.18 |
| **Civil Aircraft** | | | | | | | | | | | | | | | | | | |
| DC-9 | 3.10 | 0.00 | 3.10 | 3.10 | 0.00 | 3.10 | 0.00 | 0.00 | 0.00 | 3.10 | 0.00 | 3.10 | 3.10 | 0.00 | 3.10 | 6.20 | 0.00 | 6.20 |
| MU-3A | 0.31 | 0.00 | 0.31 | 0.31 | 0.00 | 0.31 | 0.00 | 0.00 | 0.00 | 0.31 | 0.00 | 0.31 | 0.31 | 0.00 | 0.31 | 0.62 | 0.00 | 0.62 |
| Beech | 0.48 | 0.00 | 0.48 | 0.48 | 0.00 | 0.48 | 0.00 | 0.00 | 0.00 | 0.48 | 0.00 | 0.48 | 0.48 | 0.00 | 0.48 | 0.96 | 0.00 | 0.96 |
| Subtotal | 3.89 | 0.00 | 3.89 | 3.89 | 0.00 | 3.89 | 0.00 | 0.00 | 0.00 | 3.89 | 0.00 | 3.89 | 3.89 | 0.00 | 3.89 | 7.78 | 0.00 | 7.78 |
| **Totals** | 23.61 | 7.64 | 31.25 | 23.61 | 7.64 | 31.25 | 37.11 | 0.00 | 37.11 | 60.72 | 7.64 | 68.36 | 60.72 | 7.64 | 68.36 | 121.44 | 15.28 | 136.72 |

## D.2 RELATIVE CONTRIBUTIONS OF C-5 AND TRANSIENT AIRCRAFT OPERATIONS TO DNL LEVELS

To provide an indication of the relative contributions of C-5 operations in support of forces in the gulf in comparison to the contribution of transient military and civil aircraft operations, the NOISEMAP program was used to predict the DNL levels for C-5 operations alone and for transient military and civil aircraft only. The resulting contours are shown in Figures D.1 and D.2 respectively. Comparison of these contours indicates that C-5 operations clearly dominate the noise environment in the vicinity of Westover AFB and the effects of any changes in transient military or civil aircraft operations would be insignificant with respect to noise impacts.


**Figure D.1** Contibution of Current C-5 Operations to DNL Levels at Westover AFB

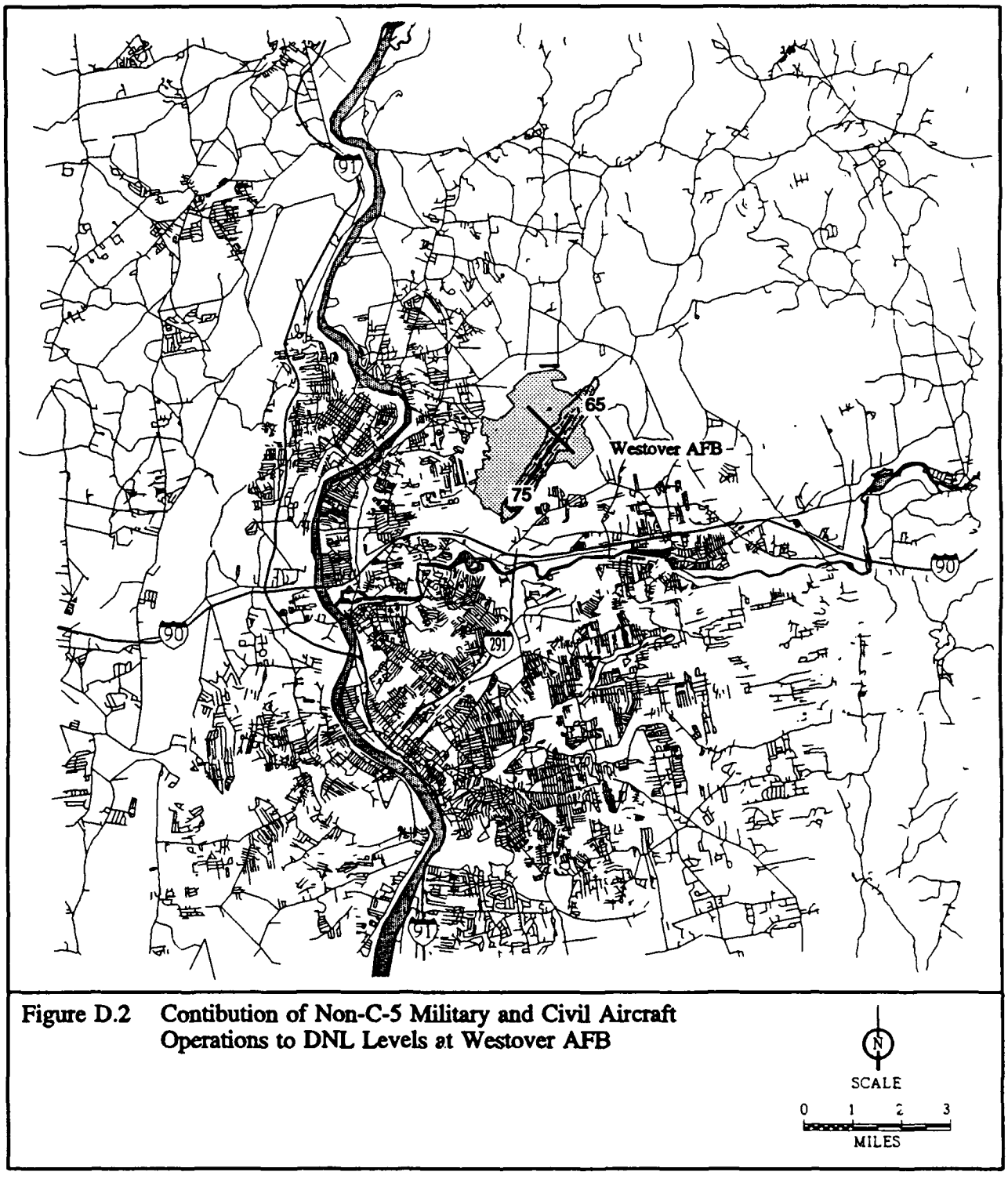


**Figure D.2** Contibution of Non-C-5 Military and Civil Aircraft Operations to DNL Levels at Westover AFB

## D.3 SUPPLEMENTAL NOISE ANALYSIS

To provide additional information on the effects of the proposed changes in operations and mitigation alternatives, noise levels at specific points in the vicinity of Westover AFB were determined. Figure D.3 shows the locations of the specific points selected for analysis and Tables D.2 and D.3 compare the DNL and maximum C-5 SEL values, respectively, at these points for current operations and for projected operations with various mitigation alternatives.

**Table D.4** Comparison of SEL Values at Specific Points for Alternatives for Projected Operations at Westover AFB

| Location | Alternatives | | | | | |
|---|---|---|---|---|---|---|
| | #1 Continue Night Runway Use | #2 Discontinue Night Runway Use | #3 Alternate Departures on RW 23 | #4 Alternate Departures on Both RWs | #5 Night & Alternate on RW 23 | #6 Night & Alternate on Both RWs |
| N1 | 112.4 | 112.4 | 112.4 | 112.4 | 112.4 | 112.4 |
| N2 | 117.3 | 117.3 | 117.3 | 117.3 | 117.3 | 117.3 |
| N3 | 107.7 | 107.7 | 107.7 | 107.7 | 107.7 | 107.7 |
| N4 | 89.5 | 89.5 | 89.5 | 101.4 | 89.5 | 101.4 |
| N5 | 106.6 | 106.6 | 106.6 | 106.6 | 106.6 | 106.6 |
| N6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 |
| S1 | 106.6 | 106.6 | 102.0 | 102.0 | 102.0 | 102.0 |
| S2 | 98.4 | 98.4 | 98.6 | 98.6 | 98.6 | 98.6 |
| S3 | 108.7 | 108.7 | 103.9 | 103.9 | 103.9 | 103.9 |
| S4 | 105.6 | 105.6 | 100.7 | 100.7 | 100.7 | 100.7 |
| E1 | 97.4 | 97.4 | 97.6 | 97.6 | 97.6 | 97.6 |
| E2 | 78.0 | 78.0 | 78.3 | 78.3 | 78.3 | 78.3 |
| W1 | 80.3 | 80.3 | 80.6 | 80.6 | 80.6 | 80.6 |

See Section 2.2.5 for description of alternatives

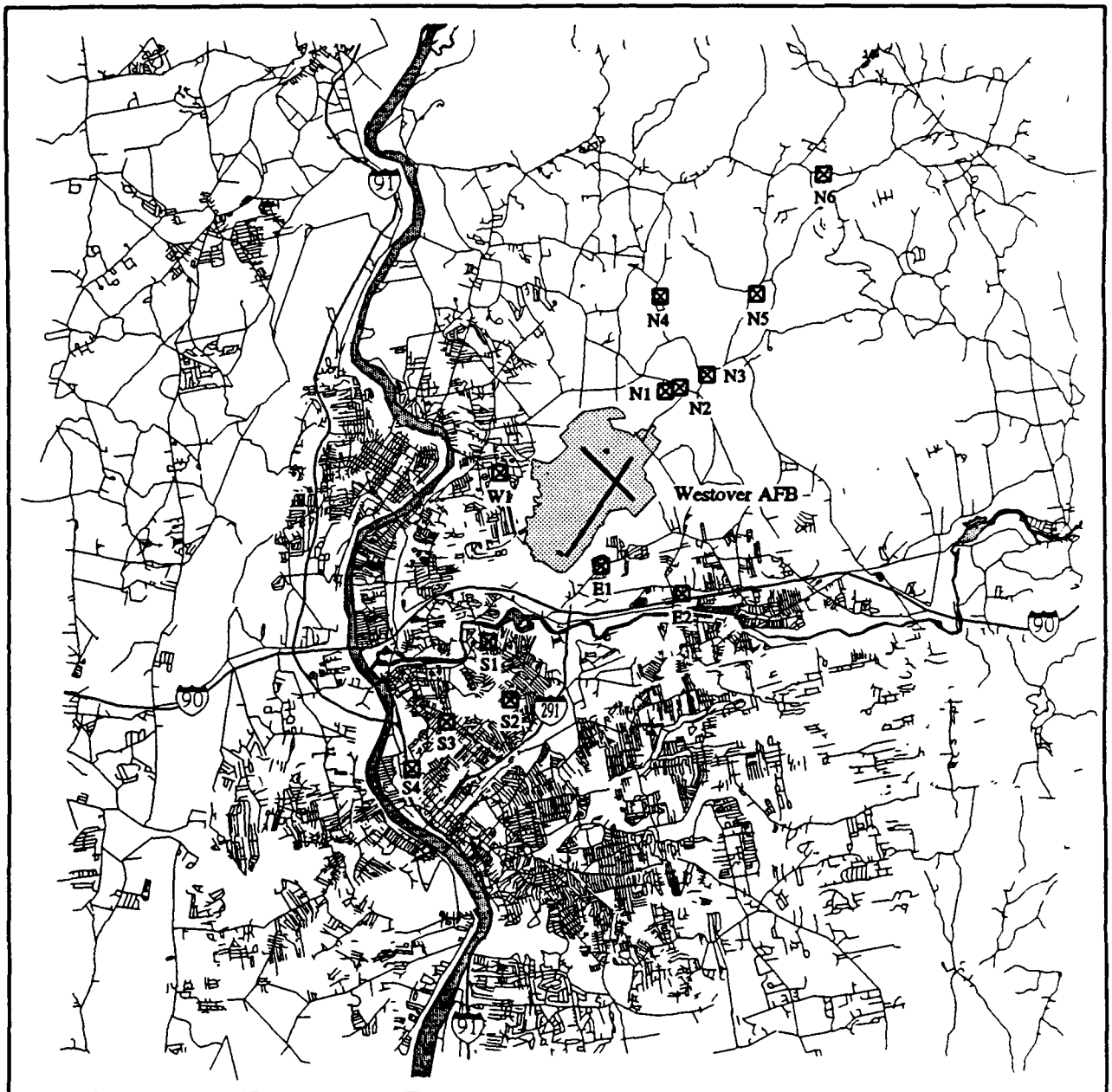


**Figure D.3** Location of Specific Points Identified for Noise Analysis

N

SCALE

0 1 2 3

MILES

**Table D.5** Comparison of DNL Values for Alternatives for Projected Aircraft Operations at Westover AFB

| Location | Alternative | | | | | |
|---|---|---|---|---|---|---|
| | #1 Continue Night Runway Use | #2 Discontinue Night Runway Use | #3 Alternate Departures on RW 23 | #4 Alternate Departures on Both RWs | #5 Night & Alternate on RW 23 | #6 Night & Alternate on Both RWs |
| N1 | 79.9 | 77.3 | 77.2 | 77.0 | 79.9 | 79.4 |
| N2 | 84.9 | 83.3 | 83.3 | 83.1 | 84.9 | 84.4 |
| N3 | 75.2 | 72.3 | 72.3 | 71.6 | 75.2 | 73.7 |
| N4 | 57.6 | 53.7 | 53.7 | 60.8 | 57.6 | 66.5 |
| N5 | 73.6 | 71.0 | 70.9 | 70.2 | 73.6 | 71.9 |
| N6 | 71.3 | 69.1 | 69.1 | 68.6 | 71.3 | 70.1 |
| S1 | 70.4 | 72.8 | 68.2 | 68.2 | 65.5 | 65.5 |
| S2 | 62.6 | 65.4 | 63.2 | 63.2 | 60.4 | 60.4 |
| S3 | 71.8 | 73.5 | 66.0 | 66.0 | 63.6 | 63.6 |
| S4 | 68.9 | 70.7 | 62.7 | 62.7 | 60.3 | 60.3 |
| E1 | 67.1 | 67.1 | 67.2 | 67.2 | 67.1 | 67.1 |
| E2 | 47.9 | 47.7 | 48.0 | 48.0 | 48.0 | 48.0 |
| W1 | 49.6 | 49.5 | 49.8 | 49.8 | 49.7 | 49.7 |

See Section 2.2.5 for description of alternatives.